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**INFORMATION PACKET:**  
**ALTERNATIVES TO PVC BUILDING MATERIALS**

ABAG Dioxins Task Force Handout  
5/28/02

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- Which Windows are the Greenest? (Environmental Design + Construction magazine)
- Siding Materials (NorCal ADPSR Architectural Resource Database, Building Less Waste)
- Roofing Materials (NorCal ADPSR Architectural Resource Database, Building Less Waste)
- Plumbing Systems (NorCal ADPSR Architectural Resource Database, Building Less Waste)
- Green Building Materials Resource Guide (Alameda County Waste Management Authority)
- List of Resources

Note: The NorCal ADPSR material is oriented more toward residential buildings, however the information is still considered useful and so has been included.

## PVC in Buildings: Hazards and Alternatives

Polyvinyl chloride, commonly known as "PVC" or "vinyl," is one of the most common synthetic materials. PVC is a versatile resin and appears in thousands of different formulations and configurations. Among plastics, PVC is second in quantity used only to polyethylene. Approximately 75% of all PVC manufactured is used in construction materials.

### PVC: A major environmental health disaster

PVC is the worst plastic from an environmental health perspective, posing major hazards in its manufacture, product life and disposal.

**Toxic Manufacturing Byproducts:** Dioxin (the most potent carcinogen known to science), hydrochloric acid and vinyl chloride are unavoidably created in production of PVC and can cause severe health problems, including:

- Cancer
- Endometriosis
- Neurological damage
- Immune system damage
- Respiratory problems
- Liver and kidney damage
- Birth defects

In the US, PVC is manufactured predominantly near low-income communities in Texas and Louisiana. The toxic impact of pollution from these factories on these communities has made them front line struggles in the environmental justice movement.

**Global impact:** Dioxin's impact doesn't stop there. As a persistent bioaccumulative toxin (PBT), it does not breakdown rapidly and travels around the globe, accumulating in fatty tissue and concentrating as it goes up the food chain. Dioxins from Louisiana manufacturing plants migrate on the winds and concentrate in Great Lakes fish. Dioxins are even found in hazardous concentrations in the tissues of whales and arctic polar bears. The dioxin exposure of the average American already poses a

calculated risk of cancer of between 1 in 100 and 1 in 1,000 - thousands of times greater than the usual standard for acceptable risk. Most poignantly, dioxins concentrate in breast milk to the point that human infants now receive high doses, orders of magnitude greater than those of the average adult.

**Lethal additives:** PVC is useless without the addition of a plethora of toxic chemical stabilizers - such as lead and cadmium - and phthalate plasticizers. These leach, flake or outgas from the PVC over time raising risks from asthma to lead poisoning to cancer.

**Deadly Fire Hazard:** PVC poses a great risk in waste incineration and building fires, as it releases deadly gases such as hydrogen chloride long before it ignites. As it burns, it leaves behind toxic dioxin waste.

**Can't be readily recycled:** The multitudes of additives required to make PVC useful make large scale post consumer recycling nearly impossible and interfere with the recycling of other plastics. The Association of Post Consumer Plastics Recyclers declared it a contaminant in 1998.

### PVC is widespread in the construction industry

While the many problems associated with PVC throughout its lifecycle far outweigh the minimal benefits, the construction industry has been unaware of its true cost and long considered it a cheap wonder material. Piping, vinyl siding, and vinyl flooring are the largest and most familiar uses of PVC. Roof membranes are another growing area. It also shows up in electrical wire, conduit, junction boxes, wall coverings, carpet fibers and backing, windows, door frames, shades and blinds, shower curtains, furniture, flues, gutters, down spouts, waterstops, weatherstrip, flashing, moldings and elsewhere. Fortunately, for each of these uses, there exists a wide range of cost effective alternative materials that pose less of a health hazard than does PVC.

## The alternatives are ready

Many cost-effective alternatives have been long available that avoid the health hazards of PVC to both workers and the larger community. Listed below are some examples of the many commercially available materials that can readily replace PVC products:

- **Piping**  
Cast iron, steel, vitrified clay, and plastics such as HDPE (High Density Polyethylene).
- **Siding**  
Fiber-cement board, stucco, recycled or reclaimed or FSC certified sustainably harvested wood, OSB, brick, and polypropylene.
- **Roofing Membranes**  
TPO (thermoplastic polyolefin), EPDM (ethylene propylene diene monomer), FPO, MBM, NBP polymers and low-slope metal roofing.
- **Flooring & Carpet**  
Natural linoleum, bamboo, ceramic tile, carpeting with natural fiber backing, reclaimed or FSC certified sustainably harvested wood, cork, recycled rubber, concrete, Stratica and other nonchlorinated plastics.
- **Wall Coverings & Furniture**  
Natural fibers (wood, wool, etc), polyethylene, polyester, paint.
- **Electrical Insulation and Sheathing**  
Halogen free, linear low-density polyethylene (LLDPE), thermoset crosslinked polyethylene (XLPE)
- **Windows & Doors**  
Recycled, reclaimed or FSC certified sustainably harvested wood, fiberglass, and aluminum.

## Join the move away from PVC

Architectural firms, governments and major corporations all over the world are dropping PVC. A wide range of major corporations ranging from Nike, Mattel and Lego to GM, VW and Honda have begun the switch to alternative materials. NY State has banned PVC pipe. An increasing number of major projects, from the UK-French Chunnel to the U.S. EPA headquarters in DC to the 2000 Olympic village in Sydney Australia, vastly reduced or completely eliminated use of PVC and more are following from the US Navy, NASA, and the NY Subway system.

Replacing PVC in your projects is easier than you may think. A number of resource guides are available to help you find green construction materials. But beware: some construction materials labeled "green" actually contain recycled PVC/vinyl. The Healthy Building Network web site (see below) includes charts of PVC free building materials, plus links to some of the best of the web's other green building resources.

## For more information:

- **Healthy Building Network:** Charts of PVC free building materials and more information on the hazards of PVC, including a review of the science  
[www.healthybuilding.net](http://www.healthybuilding.net)
- **Environmental Building News:** Article discussing issues around a phase out of PVC  
[www.buildinggreen.com/features/pvc/pvc.html](http://www.buildinggreen.com/features/pvc/pvc.html)
- **HDR Architecture:** White paper on why HDR avoids PVC  
[www.hdrinc.com/architecture/sustain](http://www.hdrinc.com/architecture/sustain)
- **Center for Health & Environmental Justice:** Information on Health Care Without Harm and related efforts to eliminate PVC and other dioxin sources  
[www.chej.org/techassist.html](http://www.chej.org/techassist.html)

(5/7/02)

TO: Mark Palmer

FR: Tom Lent

DT: 1/17/2002

RE: **PVC Reduction proposed wording for revision of the SF REB**

This language follows the model of the Seattle supplement to LEED and supersedes the PVC portion of the earlier submission.

#### **San Francisco Prerequisite**

In accordance with the resolution on dioxin sources passed March 22, 1999 by the San Francisco Board of Supervisors, design teams for City construction projects shall specify that no products containing PVC (polyvinyl chloride or vinyl) shall be used for interior finishes, including resilient flooring, carpet, moldings, wall covering, ceiling tiles, shade and blinds. Products containing PVC shall also not be used in roof membranes, sealants and adhesives, door and window frames, shower curtains, siding, gutters and down spouts, flashing, or waterstops.

#### **Additional San Francisco Recommendations:**

Project design teams and contractors are also encouraged to eliminate PVC containing products in other areas wherever practical alternatives exist, including but not limited to piping, wiring, conduit, junction boxes, flues, furniture, weatherstrip and hardware.

Design teams are encouraged to apply for an innovation credit for PVC reduction for buildings that are to be certified by the USGBC LEED program.

## Cost Background

There is a wide range of alternative products available for most of these applications. Some are actually cost competitive in first cost, many others make up their additional cost in O&M savings. Below is a brief summary of cost issues for some of the alternatives. Some are drop in replacements, others, while not inherently more expensive to install, may require one time retraining in modified techniques as with any new product.

**Resilient flooring:** A wide range of resilient flooring options (natural linoleum, rubber, cork, and Stratica) and other wood, terrazzo, quarry and ceramic tile all can substitute for vinyl in different flooring applications. VCT and vinyl sheet can generally be obtained more cheaply than the alternatives but frequently end up substantially more expensive in life cycle costing analyses than many of the alternatives.

**Carpet:** PVC primarily shows up in carpet backings, sometimes as virgin and sometimes as recycled PVC. Both should be avoided. Cost competitive options are available for mid range commercial carpets

**Vinyl wall covering:** In addition to the other hazards of PVC, this wall covering is implicated in the encouragement of mold growth due to the fact that it does not breathe. A wide range of safer alternatives exist over a wide price and quality range.

**Other interior finishes:** There are non PVC alternatives available for other interior finishes where PVC is sometimes used (moldings, ceiling tiles, shade and blinds). I have not yet done market cost analysis on these.

**Roof membranes:** TPOs (thermoplastic polyolefins) and EPDM (ethylene propylene diene monomer) are competitive or cheaper in first costs with similar life span and comparable replacement and maintenance costs.

**Pipes:** HDPE (high density polyethylene) pipes are competitive - sometimes cheaper -- in first costs with similar life span and comparable replacement and maintenance costs. Cast iron is more expensive but is long lasting and has a much lower expansion co-efficient. Vitrified clay can be comparable to PVC in cost and very long lasting.

**Wiring:** Non halogenated cables are more expensive in first cost, but several major institutions (such as the NY subway system and the US Navy) have elected to use them due to the extreme health hazard in case of fire with standard halogenated ones.

## PVC Free Building Material Alternatives

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Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
*** 02630 - SEWER SYSTEMS (piping)*** see 15100 for full discussion of pipes							
Vitrified clay							
HDPE							
*** 02660 - WATER SYSTEMS (piping)***							
Copper							
Ductile Iron							
*** 02810 - IRRIGATION (piping) ***							
Copper							
HDPE							
*** 07100 - WATERPROOFING (Water stops) ***							
Bentonite	CETCO RX	expands with water contact					<a href="http://www.celco.com">www.celco.com</a>
Butyl rubber	Henry Hydroflex	expands with water contact					<a href="http://www.henry.com">www.henry.com</a>
Bitumen asphalt	Henry Synkoflex	non swelling preformed adhesive					<a href="http://www.henry.com">www.henry.com</a>
Urethane	MME Hydrolite	expands with water contact					<a href="http://www.mulliurethanes.com">www.mulliurethanes.com</a>
TPV (Thermoplastic vulcanizite)	JPS Earth Shield	elastomeric rubber ribbed center bulb with preformed fittings	*Pro: withstands higher temperature swings				<a href="http://www.jpsspecialties.com">www.jpsspecialties.com</a>

## PVC Free Building Material Alternatives

Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
<b>*** 07450 - SIDING ***</b>							
Wood	Menominee Tribal, Maibec, Big Creek Lumber, others	Board siding or shingle. Commonly cedar, redwood, cypress, and pine		Seek reclaimed and/or FSC certified sustainably harvested wood. Avoid old growth			<a href="http://www.certifiedwood.com">www.certifiedwood.com</a>
							<a href="http://www.forestworld.com">www.forestworld.com</a>
							<a href="http://www.earthsourcewood.com">www.earthsourcewood.com</a>
Engineered wood	CollinsWood TruWood	Lap board siding		*Pro: SCS certified 50% recycled/reclaimed wood FSC certified available			<a href="http://www.collinswood.com">www.collinswood.com</a>
OSB (Oriented Strand Board)	Louisiana Pacific	Board siding of aspen and pine and MDI binder	25 year warranty (prorated after 5 yrs)	*Pro: no formaldehyde binder, uses fast growing species instead of old growth *Con: MDI hazardous in manufacture			
Textured plywood	APA T1-11	Board siding		*Pro: combined sheathing & siding means less material use *Con: needs higher quality logs than OSB. Uses phenol formaldehyde binder	one of lowest cost alternatives		
Stucco		Coating with cement and lime or polymer (acrylic or butyl) or combination	Integral color can make painting unnecessary	*Con: cement has high embodied energy, polymers release toxins in manufacture			
Brick		Masonry facing	Durable low maintenance				
Fiber cement	James Hardie, Hardie Board	Board or shingle siding of wood waste and cement	Durable (50 year warranty) low maintenance	*Pro: wood process waste fiber *Con: high embodied energy in cement		James Hardie Building Products, 800-942-7343	<a href="http://www.jameshardie.com">www.jameshardie.com</a>
Polypropylene	Certainteed Cedar Impressions, L-P, Alcoa Mastic Cedar Discovery	Board or shingle siding (note Alcoa, Certainteed and Louisiana Pacific all also make vinyl siding)	Low maintenance, 50 year failure warranty, 7 year "excessive fade"				



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<b>*** 07530 - ROOF MEMBRANES for low slope roofs***</b>							
<b>TPO (Thermoplastic Polyolefin)</b>	<b>Stevens EP, Firestone UltraPly</b>	Commercial / residential polyester reinforced membrane	White, gray, colors or black, heat weldable, weather like EPDM w/o the seam failure issues	*Pro: white color good for cool roofs, can be downcycled	less expensive than PVC in 99	see roof membrane chart	<a href="http://www.stevensroofing.com">www.stevensroofing.com</a>
							<a href="http://www.firestonebpcq.com">www.firestonebpcq.com</a>
<b>EPDM</b>	<b>Firestone Rubbergard MaxFR</b>	Commercial / residential membrane	Black			see roof membrane chart	<a href="http://www.firestonebpcq.com">www.firestonebpcq.com</a>
<b>FPO (Flexible Polyolefin Alloy)</b>	<b>Sarnafil T</b>	Commercial membrane	White, heat weldable	*Pro: white color good for cool roofs, can be downcycled (NOTE: most Sarnafil products are PVC)		see roof membrane chart	<a href="http://www.sarnafilus.com">www.sarnafilus.com</a>
<b>MBM (Modified Bitumen) SBS (Styrene Butadiene Styrene)</b>	<b>Consolidated Fiberglass Products, MB Technology,</b>	Commercial / residential asphaltic rubber membrane	torch applied			see roof membrane chart	
<b>MBM (Modified Bitumen) APP (Acstatic polypropylene)</b>		Commercial / residential asphaltic rubber membrane	hot asphalt, torch or cold applied	*Con: high emissions from hot asphalt application		see roof membrane chart	
<b>NBP (Nitrile butadiene polymer)</b>		Commercial polyester reinforced membrane				see roof membrane chart	
<b>Metal</b>	<b>Many</b>	Commercial / residential rigid roof				see roof membrane chart	

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<b>*** 08000 - DOORS &amp; WINDOW FRAMES ***</b>							
Wood	Andersen & others	Residential and light commercial	*Pro: Much lower thermal expansion coefficient and generally more durable than PVC. *Con: requires more maintenance but if maintained should last longer. Engineered wood products may require less. Aluminum cladding can avoid maintenance as well.	Seek recycled, reclaimed and/or FSC certified sustainably harvested wood		Andersen Window, Bayport, MN 612-439-5150	<a href="http://www.Andersonwindows.com">www.Andersonwindows.com</a>
Fiberglass	Carado	Commerical / residential, polyester resins and glass fibers mixed and extruded. Carado uses Timberstrand eng wood core.	*Pro: Much lower thermal expansion coefficients and generally more durable than PVC. Low maintenance	*Con: Fiberglass processing emits significant air pollution. Difficult to recycle, no recycled content	Less than custom wood frames but more than other standard types	Fibertec, Inline Fiberglas	<a href="http://www.inlinefiberglass.com">www.inlinefiberglass.com</a>
recycled HDPE (high density polyethylene plastic)	Center Industries			*Pro: 90% recycled HDPE		Center Industries Sioux Center, IA 712-722-4049	
Aluminum	Many		*Pro: durable and low maintenance. Much lower thermal expansion coefficients. *Con: Higher heat loss even with good thermal barriers. Prone to indoor condensation	*Pro: can use recycled materials *Con: energy intensive to make			

## PVC Free Building Material Alternatives

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<b>*** 09510 - ACOUSTICAL CEILING TILE ***</b> (beware of PVC as protective surface coating)							
Mineral wool	Armstrong	recycled mineral wool & newsprint paper	Humiguard 10-15 year mold/mildew warranty NOTE: some Armstrong ceiling products use vinyl latex surface finish	*Pro: 25-85% recycled content - mineral wool (mostly PI from steel industry waste ) & newsprint paper. Armstrong is beginning to reclaim old panels for PC recycling		Armstrong World Industries, Lancaster, PA 877-276-7876	<a href="http://www.ceiling.com">www.ceiling.com</a>
Mineral wool	USG	recycled mineral wool & newsprint paper	*Pro: Astro has high NRC rating of .50 to .60, a CAC rating of 35 to 39 and a high LR (light reflectance) value of .85. *Aegis Microbe Shield" treatment for mold mildew resistant w/10-30 yr warranty(humidity not water) NOTE: some USG products come vinyl faced: Clean Room ClimaPlus, Orion 210, Premier Hi-Lite ClimaPlus, SHEETROCK® Brand Lay-in Clean Room Vinyl.	*Pro: 40-85% recycled content - mineral wool (mostly PI from steel industry waste ) & newsprint paper. Some PC recycling of old panels from "select customers"		USG, Chicago, IL 800.874.4968 usg4you@usg.com	<a href="http://www.usg.com">www.usg.com</a>
Perlite	Chicago Stone Eurostone	perlite, ceramic clay and a liquid glass binder, no phenol resins	*Pro: not support mold, bacteria, or fungus, impervious to water, humidity, heat and flame, 30 yr + life			Chicago Stone 877-249-6175	<a href="http://www.chicago-metallic.com/cmc1-4-5.htm">http://www.chicago-metallic.com/cmc1-4-5.htm</a>
Wood fiber	Tectum	aspen wood fibers in an inorganic hydraulic cement binder, commonly used in schools,	*Pro: more durable *Con: lower acoustical performance, harder to cut		more expensive than standard ACT	Tectum, Inc, Newark, OH (888) 977-9691, (740) 345-9691 aird@tectum.com	<a href="http://www.tectum.com">www.tectum.com</a>
<b>*** 09640 - WOOD FLOORING***</b> (as substitute for vinyl resilient floor)							
Wood		FSC certified plank and floating floors		Also can seek reclaimed wood flooring			<a href="http://www.certifiedwood.com">www.certifiedwood.com</a>
							<a href="http://www.forestworld.com">www.forestworld.com</a>
							<a href="http://www.earthsourcewood.com">www.earthsourcewood.com</a>

## PVC Free Building Material Alternatives

Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
<b>*** 09650 - RESILIENT FLOORING *** (see resilient flooring chart for more detail)</b>							
Natural linoleum	Forbo, Armstrong	plant based tile and sheet goods from flax linseed oil, wood flour, pine resins, and natural colorants, sheet good w/ jute backing or tile with polyester backing	*Pro: anti static, anti bacterial, long wear life (40+ yrs?), minimal maintenance requirements (no stripping and waxing), *Con: not recommended for wet environments. NOTE: Forbo is heavier duty commercial grade than Armstrong	+rapidly renewable, decomposes in dump -Outgases VOCs (no known carcinogens or repro development toxins, but can be allergen problem for certain sensitive people)	\$3 - \$6 installed in 02	See resilient chart	See resilient chart
Bamboo		standard plank flooring product made from laminated bamboo (also available in floating floor)	*Pro: more resilient than red oak, good water resistance	*Pro: rapidly renewable resource (4 years to maturity) *Con: unknown labor practices in SE Asia, some bamboos use urea formaldehyde binders	comparable to hardwood floor	See resilient chart	See resilient chart
Cork		tile and plank and floating floor from natural cork	*Pro: anti bacterial, mildew, mold, rot resistant, fire retardant, thermal, vibration and acoustic barrier, soft, warm under foot, self healing, thermally stable, hypo-allergenic, durable, long wear life (many high traffic installs from 1920s still in use), minimal maintenance requirements (no stripping and waxing)	*Pro: rapidly renewable (harvestable every 9-10 years for 100-150 yrs) healthy for tree, Often use cork waste *Con: Some manufacturers use urea formaldehyde binders	\$3 - \$8 installed in 01	See resilient chart	See resilient chart
Polymer	Armico Stratica	polymer resin/ ethylene copolymer product akin to high end vinyl, comes in 333 mm (13 1/2") & 500 mm 19" squares and 1000mm (4") X 1000mm (39") planks. (Base sheet is 1000mm square)	sophisticated patterns, realistic wood and stone prints, drop in replacement for vinyl, Claims highly stain resistant and 10X tough as lino (same Surlyn wear layer as golf balls - 10 yr wearout guarantee) plus eliminates need for waxing, claims low impact and reflected noise	*Pro: VOC, PVC and plasticizer free, solvent free adhesive, certified ISO 14001, recyclable *Con: petrochemical based, due to adhesives probably only practical for post industrial recycling	slightly above high end vinyl (\$6.50/sf per Armico rep in 01 in CA), installation equal, maintenance near 0	Armico Intl., Atlanta, GA 404-267-1900	<a href="http://www.stratica.com/">www.stratica.com/</a>
Rubber		Both virgin and recycled rubber sheet and tile goods	+ anti bacterial, mildew, mold, rot resistant, long wear life, some have minimal maintenance requirements (no stripping and waxing)	Rubber floor products differ widely. Some outgas VOCs, have odor, others are very clean	\$3- \$10/sf in 01	See resilient chart	See resilient chart

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*** 09680 - CARPET *** (See carpet chart for more detail)							
Natural fibers (Wool, jute, other grasses)		Broadloom carpet					
Nylon 6	Mohawk Evergreen	Broadloom & modular carpet		*Pro: closed loop recycling (face only, backing still downcycled)		Mohawk, Atlanta GA	<a href="http://www.infinitynylon.com">www.infinitynylon.com</a>
	Shaw Eco solution/ EcoWorx					Shaw Contract, Dalton GA 800-441- 7429	<a href="http://www.shawcontract.com">www.shawcontract.com</a>
Polyurethane	Milliken Image	Polyurethane modular carpet in 3' tile	*Pro: Non VOC adhesive is releasable for easier change out, 3' tiles mean fewer seams, custom patterns available	*Pro: designed for EarthSquare process. *Con: only 4% recycled content		Milliken, Spartanburg, SC 864-503-2506	<a href="http://www.milliken.com">www.milliken.com</a>
Reuse	Milliken EarthSquare Renewal process	Renewal process of deep cleaning, retexturing and restyling modular carpet 2X for up to 30 year life. (can be done on many non Milliken carpets)	*Pro: Non VOC adhesive is releasable for easier change out	*Pro: true reuse, tho limited to two reuses cycles before downcycling, like Interface company wide approach to enviro issues		Milliken, Spartanburg, SC 864-503-2506	<a href="http://www.earthsquare.com/">www.earthsquare.com/</a>
Nylon 6,6	Interface Wabi & Sabi / NexStep	20" tile carpet recycled 6,6 nylon, high density urethane NexStep backing,	*Pro: polycarbonate seam sealer moisture impervious, Non VOC adhesive is releasable for easier change out (NOTE Some Interface backings contain PVC)	*Pro: incorporates recycled material, "zipper" for easy 100% recycling, factory is solar powered, low energy dye process. Company will recycle or repurpose old carpet *Con: Can only downcycle at this time. Not closed loop		Interface, Atlanta GA	<a href="http://www.interfaceinc.com">www.interfaceinc.com</a>

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Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
<b>*** 09700 - 09900 - WALL COVERINGS ***</b>							
Wood fiber/ polyester	Innvironments / Allegory	NOTE: Some Innovations products contain vinyl	Type II rating, Class A flame, Washable, but not scrubbable, more permeable than vinyl, may reduce mold growth behind it. Not for high moisture areas	*Pro: no heavy metals or formaldehyde	less than most vinyl products (\$13/yd in 6/2000)	Innovations in Wallcoverings NY, NY, 212-807-6300	<a href="http://www.innovationsusa.com">www.innovationsusa.com</a>
Polyester	Pallas Cares		Some use Avora FR flame and stain resistant	recyclable	\$20-\$55/yd (05/02)	Pallas, Green Bay, WI 800-4PALLAS	
Polyethylene	Xorel		38 designs, 400 colorways, non absorbent, stain resistant and aggressively scrubbable, inherently flame retardant Class A & Class 1 areas, anti- bacterial, antifungal and anti-staph, self healing, no fade in 10 years of use	*Pro: non toxic	\$21.50/yd+	Carnegie Fabrics, Rockville Cntr, NY 516-678-6770 800- 727-6770	<a href="http://www.xorel.com">www.xorel.com</a>
Polyethylene	DesignTex	100% recycled PE (NOTE: some Design Tex products are vinyl)	9 colorways		\$18/yd	DesignTex 800-221- 1540	<a href="http://www.dtex.com">www.dtex.com</a>
Cellulose	Duraprene	reprocessed cellulose fibers from tree farms bonded in latex under high pressure	Class A fire rating, equiv to Type II vinyl, abrasion and stain resistant, washable and scrubbable		\$15-18/yd (2/02)	Blumenthal 860-824- 8000	<a href="http://www.blumenthalwallcoverin&lt;br/&gt;g.com">www.blumenthalwallcoverin g.com</a>
Recycled paper	Dialtones, Thatch	Japanese phonebooks		50-75% recycled phone books, rest paper pulp	\$13.50-\$15/yd (05/02)	Pallas, Green Bay, WI 800-4PALLAS	<a href="http://www.pallastextiles.com">www.pallastextiles.com</a>
Polychromatic finish coatings		look for low VOC water-based formulas	100s of color combinations, Class A fire rating stain resistant, abrasion resistant, washable, scrubbable, resistant to fungus and bacteria, unlike vinyl, can be touched up		\$4.5 to \$13/yd	Polomyx and Zolotone	
Wool/ Ramie	McDonough Collection		Custom high end fabric	Pro: low impact manufacturing	\$59/yd	DesignTex 800-221- 1540	<a href="http://www.dtex.com">www.dtex.com</a>
Fabric		Many other natural fiber and other fabric alternatives are available					
Wood fiber	Tectum	See 09510 acoustical ceiling tile					

## PVC Free Building Material Alternatives

Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
<b>*** 10800 - BATH (shower curtains) ***</b>							
Nylon							<a href="http://www.valiantproducts.com">www.valiantproducts.com</a>
Polyester							<a href="http://www.a-1textiles.com">www.a-1textiles.com</a>
Cotton			Con: requires more care to keep mold free	Pro: renewable resource			
Glass		rigid door					
none		design open shower without curtain					
<b>*** 12490 &amp; 12500 - WINDOW TREATMENTS &amp; FURNITURE (fabrics) *** See 9700 wall coverings for more discussin of fabrics</b>							
Wool/ Ramie	Climatex Lifecycle	Wool/Ramie blend, no carcinogens, toxic chemicals or heavy metals		*Pro: low impact manufacture, compostable at end of life		Carnegie Fabrics 800-727-6770	<a href="http://www.carnegiefabrics.com">www.carnegiefabrics.com</a>
Polyethylene	Xorel	See description above under wall coverings					
Natural fibers		Many other natural fiber and other fabric alternatives are available				DesignTex	

## PVC Free Building Material Alternatives

Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
<b>*** 15100 &amp; 15400 - BUILDING SERVICES PIPING &amp; PLUMBING (pipes)***</b>							
<b>HDPE (High Density Polyethylene)</b>		High Density Polyethylene plastic often used in natural gas, water supply, sewer, perimeter drain pipe and relining applications	*Pro: light, flexible, more resilient than PVC, stronger in cold weather, joints are fused rather than glued for better seal (almost leak free) and no fumes, long continuous coils, *Con: high expansion coefficient (3X PVC) that must be accommodated in high temp fluctuation environments, not recommended for high temperature apps (140+F)	*Pro: lower embodied energy (1/3 of PVC), easy to recycle	Varies. Sometimes least expensive plastic (\$.40/ft for 4" pipe compared to \$1.20 for PVC in 94, 25-35% more expensive in 2002), Fusion installation takes more time, but comes in long continuous rolls		
<b>ABS (Acrylonitrile-Butadiene-Styrene)</b>		acrylonitrile-butadiene-styrene widely used in residential drain-vent pipes	*Con: nearly twice the thermal expansion coefficient of PVC	*Con:- slightly more energy intensive to produce +/- no PVC but still involves problematic toxic chemical processes to manufacture	equal to PVC for 4" pipe in 94	widely available	
<b>Vitrified Clay</b>		Fired clay used in industrial and sewer applications	*Pro: highly chemical resistant, lowest thermal expansion coefficient, most durable of all pipe materials, many manufacturers give 100 year warranties *Con: heavy	*Pro: Low toxic manufacture, non toxic disposal *Con: low embodied energy (1/3 of PVC),	comparable to PVC in 94	harder to find, Clay Pipe Institute 602-228-1000	<a href="http://www.ncpi.org">www.ncpi.org</a>
<b>Cast iron</b>		Primarily used in waste piping	*Pro: low thermal expansion coefficient (1/5 of PVC)		twice as expensive as PVC, higher installation costs in 94		
<b>Recycled HDPE</b>	<b>Hancor / EcoFirst</b>	post industrial recycled polythylene for drainage				Hancor Inc., Findlay, OH 888-FOR PIPE	<a href="http://www.hancor.com">www.hancor.com</a>



## PVC Free Building Material Alternatives

Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
<b>*** 16000 - ELECTRICAL CABLES ***</b> (PVC is used for insulation)							
<b>LLDPE (Linear Low Density Polyethylene)</b>		Low smoke polyethylene or Linear low density polyethylene, used in airports, security, military other places where smoke from a fire is high concern					
<b>XLPE (Thermoset Crosslinked Polyethylene)</b>		substitute for XHHW-2, USE- 2/RHH/RHW-2	Building wire alternate to PVC insulated THHN, XHHW for genrl purpose, color coded, USE-2 for burial or wet apps		upcharge over PVC THHN varies by size, ~50% for AWG2, less for larger, more for smaller (2001 local SF electric house)	General Cable	<a href="http://www.generalcable.com">www.generalcable.com</a>
<b>Polyolefin</b>		Substitute for PVC coated NM-B, THHN, and THWN building wire (also datawire)				Southwire Company	

## PVC Free Building Material Alternatives

Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
<b>*** 16000 - CONDUIT &amp; EMT &amp; JUNCTION BOXES ***</b>							
<b>HDPE (High Density Polyethylene)</b>	<b>CPChem Performance Pipe</b>	High density polyethylene (ENT)	*Pro: D69 More flexible, ductile, and resilient than PVC, stronger in cold weather, joints are fused or pressure fit rather than glued for better seal and no fumes, lower COF = easier to run cable, *Con: higher thermal expansion coef but can handle it.		varies, sometimes cheaper, currently (early 02 25-35% more expensive material costs. Comparable installation. Better maintenance costs	Chevron Phillips Chemical (CPChem), Plano TX 800-527-0662,	<a href="http://www.CPChem.com/performancepipe">www.CPChem.com/performancepipe</a>
<b>HPDE</b>	<b>Arnco PermaGuard</b>	same as above				Arnco, Elyria, OH 800-321-7914	<a href="http://www.arnco.com">www.arnco.com</a>
<b>Galvanized Steel or Aluminum</b>	<b>Allied Tube</b>	Conduit (EMT)				Allied Tube, Harvey IL 800-882-5543, widely available	<a href="http://www.alliedtube.com">www.alliedtube.com</a>
<b>Fiberglass</b>	<b>Champion</b>	can replace PVC coated conduit in corrosive environments. Also make trays	Pro: low coefficient of friction			Champion Fiberglass, Spring, TX 281-353-5052	<a href="http://www.championfiberglass.com">www.championfiberglass.com</a>
<b>Nylon</b>	<b>Sealcon</b>	liquid tight flexible conduit				Sealcon Centennial, CO (303) 699-1135	<a href="http://www.sealconusa.com">www.sealconusa.com</a>

## PVC Free Building Material Alternatives

Material	Brands	Description (Application, composition)	Characteristics (features, installation, use, maintenance, performance /durability)	Impacts (use & life cycle)	Cost factors (buy, install, maintain)	Manufacturer access	Web links
*** OTHER materials still to come***							
Signage							
Molding							
Hand rails and interior wall protection							
Divider panels							
Furniture							
Shade & blinds							
Weatherstrip							
Gutters & downspouts							
Flashing							

This list is intended to provide a representative sampling of products and materials that are commercially available for a variety of applications. It is not intended to be comprehensive and in a rapidly changing market, the completeness and accuracy of this information cannot be guaranteed. Inclusion on this list does not imply endorsement by HBN of any product or manufacturer, nor any warranty of the appropriateness of listed products for a particular application.

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## FLOORING MATERIALS

### Issues

The tremendous variety of available floorcovering materials includes tile, vinyl, rubber, acrylic, cork, linoleum, carpet, wood, stone and earth. Each type has a number of variations. Choices depend upon the desired quality and usage of flooring — durability, warmth, character, maintenance requirements, and availability. It is critical to consider all performance criteria, since owner dissatisfaction leads to premature replacement.

When evaluating the choices for flooring consider:

- **Function** — What purpose does the surface serve? What kind of activity does it support? A nursery, a grocery, or a dance hall may have different user demands. Floor functions that require different surfaces may need to be zoned within the same room.
- **Traffic** — How much and what kind of traffic (e.g. cart traffic or animal claws) will it bear? A floor that wears out too quickly impacts both resources and landfills. Durable floors may have higher initial cost or environmental impact, but paybacks come through less frequent replacement.
- **Maintenance** — Floor cleaning products are notorious for their environmental and health damage. Floors that can be cleaned with a mop, like terrazzo, will not only reduce polluting cleaners but will pay for themselves in reduced maintenance costs.
- **Durability** — Specify a flooring surface that will function for the life of the structural components of the building. If this is not feasible, consider the most ecological means of replacement, repair, reuse or recycling of the material used.
- **End of use** — What will happen to the material after it is worn out? Can all or part of it be reused or recycled, or must it be landfilled? If recyclable, are there appreciable costs in energy or pollution due to manufacturing? If landfilled, does it biodegrade?
- **Indoor air quality** — Next to poor HVAC systems, the single most critical practice for good indoor air quality is to avoid using synthetic wall-to-wall carpeting. Carpets manufactured since the 1950s are mostly synthetic combinations of petroleum and chemicals. 98 percent of the carpet is polymer, which takes more than 100 years to biodegrade, if at all, causing a huge problem in landfills. It is estimated that 3 percent of urban landfill volume is carpet. The dyes, adhesives, and fiber content are all polluting and extremely toxic to workers and occupants. The carpets, backings and adhesives can offgas for years potentially causing serious health risks, especially in small children who are closer to the carpeting and spend more time on the floor in general. In recent years countless cases of allergies, headaches, hair loss, Kawasaki's Disease, depression, respiratory, and reproductive problems have been linked to new carpeting. Carpets gather and trap dust and are a perfect breeding ground for molds, bacteria, and dust mites that can cause severe allergic reactions in many people. Like paint, air out carpet as long as possible prior to move in. Some people ask the carpet manufacturer to air the carpet out for several weeks before delivery. Hard surfaced floors with removable area rugs allow for healthier cleaning and maintenance conditions.
- **Type of material** — Flooring can be made from plant-based materials, earthen materials, or petroleum products. Plant-based materials can generally be harvested continuously, and some can then be composted when no longer usable. Earthen materials are generally plentiful, although some have high embodied energy. They are generally durable, and can be recycled into other earthen products. Petroleum-based materials are generally inexpensive, but are derived from

## FLOORING MATERIALS

limited resources, create significant pollution in processing, are often linked to toxicity problems, and usually require higher maintenance. Only one synthetic carpet fiber can be recycled over and over, however, the recycling program is not well known or utilized. [see Collins & Aikman 09680]

### Plant-based Materials

Plant-based materials offer outstanding durability and minimal maintenance, which more than offset their higher initial costs.

#### Wood

Wood, a traditional flooring material, is beautiful, comfortable, and durable for both residential and commercial applications. While wood is a renewable resource, check for a stamp certifying that it was sustainably harvested. [see Structural Materials] Narrow strip flooring can be made from small, crooked, low value trees allowing the largest to be preserved.

Solid plank hardwood flooring, once the standard of the building industry, remains one of the healthiest, most durable and easiest to maintain kinds of flooring available. But the increasing rarity of forest resources has spawned several alternatives.

- Harvest of indigenous species and urban wood sources has made several renewable woods available for flooring.
- Salvaged wood is another highly recommended choice for flooring. Finished wood is one of the rare materials that actually get better with age. As moisture is released, the wood becomes stronger and more durable, and many value the mellow coloring of old wood. Demolition wood is readily remilled and finished for flooring, diverting waste and creating value. Even old Douglas fir framing lumber, properly sealed, can be used for residential and less intensively traveled flooring. Hardwoods can be salvaged for furniture or as new flooring.
- A hardwood veneer laminated over a substrate of low-grade wood or plywood looks good, but will have a shorter life span, and be less refurbishable than solid flooring. A new German technology – soon to be available here – presses wood waste products into solid plank tongue and groove flooring, pre-finished with natural resins extracted from the wood.

Wood flooring should be finished with non-toxic sealers (preferably water reducible or natural plant-chemistry products). Prefinishing can eliminate the need for wet applications onsite, allowing emissions to be controlled under factory conditions. Pre-finishing can significantly reduce the need for acclimation to the moisture conditions of the site. To prevent cupping, finish both sides and check with a moisture meter to match moisture conditions at the site.

#### Bamboo

Bamboo is gaining popularity as a flooring material. Bamboo strips are laminated into pre-finished tongue-in-groove planks (often treated for insect and fire-resistance, so be sure to ask). This material is very strong, harder than oak with significantly less expansion than hardwoods (so less gap is required at walls and connections to other flooring), durable, and best of all, is made from a plant that can produce 4-8 times as much "wood" per year as hardwood trees. It can be sanded and refinished. Unfortunately bamboo harvesting and production is somewhat labor intensive, and the supply is

## FLOORING MATERIALS

located in Vietnam and China, so it is all currently imported. Domestic bamboo propagation for the construction industry is in its infancy in several West Coast and Southern states.

### Cork

Cork flooring is being rediscovered for its natural beauty, ease of cleaning, and comfort under foot. From the bark of cork oak trees (*Quercus suber*) in Mediterranean countries, the flooring feedstock is available because of the waste generated in producing wine bottle corks. Because cork tree bark can only be harvested every nine or ten years, and the health of the oak forests are vital to the ecology and economy of the Mediterranean regions where they grow, cork production is very carefully monitored. A root fungus disease currently infecting trees in Spain and Portugal may limit the cork supply in the near future.

The cork waste is broken into fine pieces and, with agglomerating agents, baked into blocks, which are later cut into board and tile. Binding agents vary, and although many manufacturers now use natural proteins, urea formaldehyde used commonly before the 1990s, is not entirely phased out – check your source. [See "Cork Flooring," *Environmental Building News*, Vol. 5, No. 1]

Cork flooring has been used on gym floors and has proven quite resilient and strong — as long as it has adequate backing to prevent penetration. Cork should be sealed when used in wet areas like kitchens or bathrooms. Usually sold in tiles, there is little waste from installation. Material costs are in the range of \$3 to \$4 per square foot. It comes in a variety of shades and finishes, is fire resistant, an excellent sound insulator with good thermal qualities, easy to install, and non-allergenic — although there is usually a noticeable smell. If there is no urea formaldehyde binder and if it is installed with a non-toxic adhesive, cork flooring is chemically benign.

### Linoleum

Sheet flooring is usually thought of as vinyl tile or sheet vinyl, yet there is a long history of sheet goods before the advent of petroleum based products. Natural linoleum (not to be confused with vinyl marketed as "linoleum") in use for over 125 years, is a durable and easily maintained floor covering. Known as the "40 year floor," linoleum is made from cork, wood flour (a waste byproduct), linseed oil, and pine resin. Ground-up stone and wood add color. It was a standard material in kitchens and bathrooms before being supplanted by vinyl. Chemically benign (although some people are sensitive to the oil and pine resin), easy to install right over a slab with little waste, linoleum smells and looks good when installed, and, with a natural jute backing, can break down when properly composted. Although reports vary, it appears to have substantially lower embodied energy than vinyl products. Californians must factor in the economic and environmental expense of shipping, as linoleum is currently manufactured in Scotland, Holland and Eastern Canada. (On the other hand, where does our oil come from for vinyl?)

Linoleum comes in a wide range of traditional marbled colors and now several brighter contemporary colors and patterns are available. It resists indentations, cracks, abrasions, and water, making it a wonderful product for high traffic areas and wet areas. It will not ignite or melt and has unique self healing and sanitizing qualities - the seams will fuse together over time and the linseed oil in linoleum naturally kills bacteria and molds. There are several safe water-reducible adhesives on the market. Durability, performance, and easy maintenance make linoleum an excellent choice.

## Earthen and Masonry Materials

### Concrete

Simply using the concrete slab that is already there in both new and existing buildings, may be the easiest, least expensive, and soundest environmental choice. In some cases, as in a laundry room, it may be appropriate to just leave smooth-finished concrete bare. Concrete has good thermal storage capacity. If a radiant floor or passive solar heating system is incorporated, the slab could be left bare throughout, with patterns and texture scored into the concrete or area rugs added for accent. Frank Lloyd Wright used this system 60 years ago! Without such a heating system though, bare concrete may feel cold in a living space, and hard on the feet in a work space. Drainage, vapor barrier and sub-slab insulation details are particularly critical for finished concrete floors. [see Concrete Chapter] Still, making use of the concrete slab as the actual subfloor with no additional pad, underlayment, or floorcovering saves resources, cost, time, and energy.

### Terratile, Adobe, and Earthen Floors

Terratile is a wonderful handmade, site-built product consisting of clay soil and Portland cement, poured in place and then stamped with a tile pattern and sealed. It looks like a tile floor, but is softer, warmer, and the ingredients are locally derived and abundantly available. The flooring they create is durable, attractive, warm, and completely benign. The amounts and types of soil added can be altered to change the color and texture, and hand patterns can be trowelled into the tile to add individuality and life. An additional benefit is that terratile has a high thermal storage capacity. Terratile can be finished with any of several naturally breathing plant-based products.

Terracotta and terrazzo are two other high quality earth material techniques worth considering because their extreme durability and low maintenance can pay back their installation costs over time. Terrazzo has the additional benefit of being made from the waste product of the stone and marble industry.

"Royal peasant flooring" — recently so named by Hunter Black, a carpenter in the Ananda Builders Guild, is also known as poured adobe and — has been used for centuries. It is a poured, trowelled mixture of sand and clay to which fermented, diced straw is added. The resulting finish resembles the natural earthen floors of many non-western cultures. It feels soft underfoot, is durable, economical, easy to apply over a slab or wood subfloor, and has high thermal mass. It can be colored with different soil types and is usually finished with a natural oil or wax coating.

Royal peasant flooring, terratile, and cork flooring stain and retain water more easily than other flooring products unless they are sealed with hermetic films rather than breathing oils, and thus may be less appropriate for the kitchen and bathroom. Ceramic tile and natural linoleum, discussed above, are the best choices for these areas.

### Ceramic Tile

Ceramic tile is also an extremely durable and relatively inexpensive choice. It is easy to clean, freeze-proof and highly durable. With its high density and low porosity, tile works well in wet areas without a finish. Tile is recyclable — it can be ground into aggregate for re-use in concrete — and has a high thermal storage capacity. The relatively inert surface of grouted tile, if carefully installed according to ecological guidelines, makes an excellent surface for people with chemical injuries or sensitivities.

## FLOORING MATERIALS

The most common varieties are glazed or Mexican paver type unglazed and fired clay tiles. Several companies now incorporate recycled materials in ceramic tiles, including old tiles, waste glass from the manufacture of light bulbs, or from recycled automobile windshields. Other porcelain-type tiles are manufactured from waste by-products of feldspar mining. There is benefit in recycling wastes, but be careful of impurities from mining that can contaminate these products.

In all tiles, be careful of radioactive glazes particularly found in cobalt blue and certain yellow colors. Simple-to-use radiation detectors, such as the "RadAlert" meter are available commercially.

The safest mortars and grouts are pure Portland cement products without additives. The safest grout sealers are water reducible sealers with low VOCs or natural plant oils or waxes. Sodium silicate (water glass) may be painted over grout lines with an artist's brush. Beware of solvent-based sealers and solvent-based mastic-type adhesives.

### Stone

Stone is very durable and will probably never need replacing. While the use of locally derived stone can be resource efficient and aesthetically connect a building to its place, commercial stone quarrying frequently scars the local landscape, contributing to land and water pollution. Cheap foreign labor is often exploited for the quarrying and finishing of stone, which is then shipped great distances at exorbitant expense. One Midwest building called for locally quarried stone to be used, but the stone was first shipped to Italy for dressing! Despite its surface durability, stone slab is extremely fragile and much is often broken in transit. Except for the hardest stones such as granite, stone is often given a waterproof finish that requires periodic maintenance. The cost of stone probably varies more widely than any other construction material, ranging from essentially free site-found to the dearest "endangered" marble imports. With its excellent durability and ease of maintenance, locally quarried and finished stone is an appropriate choice for a long lasting floor.

## Petroleum Products

### Vinyl

As the primary components of vinyl are derived from petroleum and are damaging to the environment in every stage of production and installation, it is difficult to justify the specification of this product for any application. The manufacturing and installation of vinyl pose serious health risk to workers, and outgassing from newly installed vinyl presents additional dangers, especially to young children and pregnant mothers.

Vinyl is composed of polyvinyl chloride (PVC) or related polymers with plasticizers, fillers, stabilizers and pigments. It is produced in sheet or tile form. Sheet vinyl comes in three types; layered composite, inlaid and homogenous. The tile form is manufactured in two basic types: vinyl and vinyl composition. Vinyl composition tile has a higher percentage of inorganic filler making it more rigid, and is chemically more stable and slightly less noxious.

Vinyl flooring is among the cheapest materials available, but it is less durable than plant-based or earthen flooring. Its low cost only contributes to the mentality of disposal when it is damaged. Currently there are only limited opportunities for recycling.



## FLOORING MATERIALS

### Rubber

Resilient rubber flooring products have been developed which use 100% recycled rubber (the rubber makes up approximately 50% of the product content). This rubber is salvaged from scrap tires or tire manufacturing waste, and is sometimes mixed with cork. Be sure to check your source and do not specify rubber flooring made from virgin rubber, which uses non-renewable petroleum and causes serious air and water pollution. Because of its high capacity to absorb shock and sound, rubber flooring is often specified for playgrounds and sports facilities. Rubber flooring is very durable and resistant to breakdown, making it a potential choice for outdoor use. This, with good slip resistance made rubber the choice of the National Park Service for outdoor walkways at Alcatraz, with a very high use. It has an objectionable odor, and should be avoided indoors for healthiest indoor air quality practice.

### Carpet

Carpet can be made from natural materials, like wool or cotton, or synthetic materials, such as nylon, olefin, polyester, and propylene. Synthetic wall-to-wall carpet is one of the most frequently used flooring materials. Carpet is one of the least expensive materials available, and is easy to install. Carpet is also soft to the foot, covers slab cracks and other flaws in construction, and absorbs sound. Carpet, as typically used, has inherent flaws that force it into a pattern of disposability, and we can only reduce this with significant changes to current use patterns.

First, most carpet has a relatively short life span. In residences, carpet is usually discarded when it can no longer be cleaned, when the thread edge has become frayed causing premature unraveling, or when its color or style is no longer pleasing. In medium-use commercial areas, like offices, the carpet is worn and replaced after only about 8 years, and in high-use areas the life-span may be only 2-3 years. Second, there is often no option to re-use most wall-to-wall carpets. It is typically custom cut for a specific location, and glued down to the slab or underlayment, so that it is destroyed during removal. Third, carpet fibers are difficult to process into other materials. The high degree of molecular manipulation required to form the original fibers, limits its future use. Finally, synthetic carpet fibers do not biodegrade. While this may be seen as an advantage during the carpet's short life, its short life span creates a definite landfill problem. In urban areas, discarded carpet represents up to 3% of total landfill volume [see *biblio: Environmental by Design, Kim Leclair and David Rousseau*], one of the largest single elements.

Carpet manufacturing uses large amounts of water, discharges effluent and produces many waste by-products. Mill scraps can be converted to underlayment and, less efficiently, are sometimes used to fuel curing ovens. Technologies to separate the face fiber from the backing are being researched to find higher uses for these resources and further reduce the waste-stream from this industry. Of the synthetic carpets, those of 100% polypropylene and BASF's nylon 6xi have the greatest potential for recycling. Any carpet with synthetic latex back (styrene butadiene, or SBR) poses a problem because of the toxic 4-phenylcyclohexene (4-PC) byproduct of manufacture. Recently developed polyurethane backings are lower in emission and do not contain 4-PC. Collins and Aikman will take back for recycling, any vinyl-backed carpet of any brand, if a carpet of theirs is purchased. [see 09680] They find it cheaper to ship back to Georgia than to landfill. In addition to reworking some of it into carpet backing, the compressed recycled carpet fibers are made into parking lot tire stops [see 11160] and industrial flooring. [see 09680 Power Bloc] Allied Signal of Dalton Georgia has taken on the task of recycling carpet by seeing it as a good business move. They expect to have several hundred reclamation outlets sometime during the year 2000, each equipped with a device that determines the carpet fiber type. They will take back carpet from any mfr. as long as it is one of their preferred fiber types.

## FLOORING MATERIALS

Persuading commercial and institutional users to reconsider carpet use may prove more difficult, as initial cost and convenience are often primary concerns. But there are several steps to reduce carpet use and/ or increase longevity. In less used areas, like storage rooms, consider leaving the existing floor (usually a concrete slab) exposed, reducing material use and costs. Develop a maintenance, cleaning and replacement cost schedule to determine the actual long term costs of flooring materials. In many areas, like corridors, lobbies and reception areas, the higher first-cost for materials like terrazzo or even stone will be recouped in just a few years. Consider creative ways to reduce the area of carpet, remembering that unless it biodegrades, sooner or later it will end up in the landfill. In offices and retail spaces, carpet provides a soft walking surface and good sound absorption, but where these properties are not required: under displays, lateral files, storage areas, work surfaces, and infrequently used areas, the carpet is unnecessary. One alternate would be to use carpet runners and modules, based on the size of a workstation or store aisle. Temporarily attached, they can be moved as building sites or requirements change. Another option is to use removable carpet tiles, leased from the manufacturer who easily replaces individual squares in high-wear areas at minimal cost.

The standard for offices, stores, and corridors has been and probably will remain carpet, but there are steps you can take:

- Natural linoleum or ceramic tile is recommended, particularly for all wet areas.
- Take care to avoid using scarce resources for wood floors.
- Be aware of the glues or adhesives used in manufacture and installation of all flooring materials.

There are both alternates to carpet and to methods of its use that will make longer lasting floors and less waste. Area rugs will last as long as the building and can be salvaged and reused. (See "Rugs" at the end of this chapter.) Although these other materials may cost significantly more, the initial cost is often recovered from its durability. Some of the best solutions to waste reduction involve using durable materials that stay out of the waste stream or materials that biodegrade. Where carpet is required, there are four elements to consider: fastening, carpet, pad, and underlayment.

### Fastening

When possible, use nailing strips or hook and loop attachments instead of glue. When glue is unavoidable, choose one that is water-soluble and low-toxicity. Avoid using synthetic wall-to-wall carpeting of any kind. Use natural-fiber area rugs or grass mats stapled, tacked, or simply laid down without padding or with natural padding, over any of the number of floor surfaces described in order of recommendation below.

### Underlayment

Avoid urea-formaldehyde-emitting particleboard or interior-grade plywood. Products with no added formaldehyde, like Medex (for exterior ), Medite II (for interior use) or exterior-grade or Exposure I plywood (with the much less toxic phenol-formaldehyde) are preferable. The floor underlayment can also contain materials that can reduce waste volume. Homasote is a sound absorbing underlayment that uses recycled newspapers as a primary ingredient. It provides cushioning, even under hardwood flooring, but the cautions mentioned in Divisions 6 and 7 (under roof decking) apply. Gypsum concrete, commonly referred to by the trade name Gypcrete, can be recycled. [see Carpet, 09680]

### Carpet

Some carpeting has been developed from waste products from other industries. Several carpets are available that use PET plastic (#1 plastic, used in 2-liter soda bottles). These carpets are usually

## FLOORING MATERIALS

cut pile and will not wear well in high-volume or intense use areas. Potentially toxic stain-resistant and other treatments are used in these carpets. Backings are usually toxic SBR synthetic latex.

Some companies are beginning to develop facilities for recycling their own carpet, but this is still a proprietary process. Milliken's Earthwise Ennovations cleans, textures, and restyles previously used modular carpeting for reuse at approximately half the cost of replacing with new. Interface Carpet has taken responsibility for the lifetime of their carpet by starting a leasing program retaining ownership of the product and providing installation and maintenance services. At the end of the carpet's useful life, Interface will reclaim it for recycling. Collins and Aikman, mentioned above, has developed other products made from recycled carpet fiber, such as dock bumpers and parking stops, and has a carpet leasing program for commercial buyers. As yet, generic recycling is not available for carpet.

### *Rugs and Mats*

An alternative to the traditional rug is a natural fiber mat, most commonly made from sisal, coir, jute, and seagrass. There are a wide variety of sizes, textures, and patterns. Coir grass comes from the husks of coconuts, and sisal from Agave plants in the West Indies (and elsewhere) (or heneguen plants in South America and Africa). Both plants are indigenous and rejuvenate themselves quickly without the need for fertilizers, pesticides, or herbicides. Occasional removal and cleaning can prevent build up of dust, dust mites, molds, and bacteria. Some are highly durable, easy to clean and inexpensive. Some of the finer grass carpeting can be surprisingly soft and comfortable.

Removable area rugs will highlight and soften certain areas if desired. Most modern carpets are woven in a continuous loop, and abrasion of the thread edge causes unraveling that age it prematurely, and encourages its disposal. In traditional Persian carpet, each thread is tied in one knot, exposing only the two ends to wear. Thus, a good through-woven area rug can last for decades or even centuries. Further, a good quality area rug can be moved or sold, extending its life and reducing costs. Area rugs are also frequently made with compostable materials including cotton, wool, jute, coir, burlap and sisal. Organic materials with non-chemical dyes are becoming more and more available.

There are a number of local and international companies that produce natural-fiber rugs and carpets. Wool, cotton, and other natural fiber area rugs are available in a wide variety of colors, patterns, and sizes. Wool wears well and is flame resistant. The rugs can be naturally tinted, not dyed, and made from renewable materials. They are dense and durable. Some rugs come with woven jute backings or double backings of polypropylene adhered to jute. The single woven jute backing is the safest although it is a bit more expensive. Rugs manufactured in other countries and shipped here add to energy consumption and pollution in transportation. Also, some natural-fiber rugs may be grown with pesticides and made with exploited labor. Many natural fiber carpeting and rugs use toxic SBR backings in an effort to make more affordable products. Less expensive wool or other natural fibers are often blended with polyester or nylon, meaning they must be treated with chemicals for fire- or stain-resistance. Check sources to ensure environmentally sound and socially responsible practices.

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Posted on: 02/08/2001

## Highlights of Environmental Flooring

By John Sailer

From the wide variety and growing availability of environmental flooring come the following selected products designed for a healthy planet

Because of the growing demand for environmental building products, the flooring industry has responded with many surface finishes that fit the definition of green building product for a number of different reasons. Sustainably harvested woods, grasses, recycled and natural carpets, resilient and other flooring products composed of natural and non-toxic materials are all among the environmental flooring options available to architects and interior designers today.

### Bamboo

Bamboo can be considered an environmental flooring product due to its renewable growth process. Bamboo is a grass and, unlike traditional hardwoods, does not require replanting after harvesting. A mature bamboo forest relies on an extensive root system that continues to send up new shoots for decades.

Bamboo, which is a grass, is considered an alternative to wood and grows on a 10 year growth cycle. After reaching maturity in four years, bamboo will live another three to four years and then rot or get blown down. Harvesting bamboo at a rate of 25-28% per year allows for a sustainable harvesting process. During the annual growing process, when the new sprouts are emerging, there is a 90-day period during which time no entry is allowed in the forest.

Bamboo comes from forests in China managed as they have been for hundreds of years, without irrigation, fertilization, or pesticides. It is grown on slopes unsuitable for any other cultivation.

### Cork

Cork has been harvested in the same sustainable fashion for the past 2,500 years. Cork oak trees are found in the Iberian Peninsula, and after a 40-year maturation, the bark begins to naturally separate away from the trunk. This peeling is further accelerated in a harvesting process that has remained unchanged since at least 5 B.C. The eco-system of the cork oak forests also remains unchanged today, and one cork oak can produce bark for 100-150 years.

Cork also features other environmental attributes. It is naturally insulative, making a natural energy saver. It is hypoallergenic, and it is beneficial to indoor air quality because its natural properties resist mold, mildew, rot, and most insects.

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According to Bruce Graye of Infocork USA, the cork used in manufacturing the company's cork flooring all comes from what would otherwise be waste material, thereby making the product even more environmental. "We use the types of cork which have not enough quality for products like cork stoppers," he said, "and we use cork stoppers production waste. Some decades ago, this was not possible and considered trash. Now, with our advanced technology, we can mill this cork and select the granules with enough quality for production of our floorings."

In addition, the company offers environmental installation and maintenance products for its cork floors. The adhesives are all water-based and solvent-free with low VOC emissions.

### **Resilient Flooring**

Dodge-Regupol, a market leader in environmental rubber flooring, will soon launch Eco-Surfaces for commercial and retail end use. Eco-Surfaces is made from 100% recycled rubber. The new collection includes 34 colors in patterns of Eco-Nights, Eco-Earth, and Eco-Stone. Custom colors as well as graphic and logo inlays are also available.

To develop its environmental flooring product Stratica, Amtico International invested five years and \$17 million. Stratica is a non-vinyl, chlorine-free flooring. "Stratica's wear layer is chlorine-free, plasticiser-free, stain resistant, clear, and will not yellow with age or heat," according to the company. "Stratica resilient tile has low VOC emissions, is recyclable, and exhibits low smoke toxicity and density."

Different companies are offering carpet that could be defined as environmental for variety of reasons – if it is manufactured of all natural materials in an environmentally efficient way, if it is manufactured in the most resource-efficient means possible, if it is made of recycled materials, if it is recyclable, or a number of other reasons.

One company that is in the forefront of environmental manufacturing is Interface, Inc., of LaGrange, GA, whose CEO, Ray Anderson, is among the environmental evangelists traveling the world promoting the benefits of what he calls "the new industrial revolution," an effort to manufacture useful end products without any waste or harmful emissions.

His efforts began when he read Paul Hawken's book, *The Ecology of Commerce*, and continue today with the publication of his own book, *Mid Course Correction*. His efforts to manufacture carpet environmentally include resource reduction and recycling.

Interface's most recent effort to produce an environmental flooring product is the introduction of Solenium, a flooring product that is neither carpet nor resilient flooring. The company describes Solenium as "a new flooring product that fills the gap between the two traditional floorcovering product categories."

One of the most dramatic environmental benefits of the new product is the fact that the manufacturing process is supplemented with solar power. All of the components are recyclable, and Solenium was designed with healthcare and education facilities in mind, so the polymers used in this flooring product have superior stain resistance. Most stains can be removed with just warm water. The flooring also includes an antimicrobial ingredient to combat bacteria.

### **Linoleum**

Linoleum flooring products could be considered environmental simply because of the raw materials of which they are composed. For example, linoleum products from Forbo Industries are manufactured from readily renewable natural raw materials. Plus, production waste is re-used by feeding it back into the production process. T

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result – no waste is generated during production.

Linoleum is composed of linseed oil, limestone, cork flour, rosin, wood flour, pigments, and jute, all natural and all requiring a relatively small amount of energy for extraction. Linseed oil is obtained through the pressing of seeds of the flax plant. Limestone is found all over the world in enormous quantities. Cork flour is the ground product of the bark of the cork oak, which is peeled every seven to ten years and has no impact on the life or health of the tree. Rosin is tapped from pine trees a method that has no impact on the future growth of the trees. Wood flour used to manufacture Marmoleum and Artoleum is made from European timber grown in controlled forests where every felled tree is replaced with new plantings. The color of the company's Marmoleum and Artoleum lines are created by using ecologically responsible organic pigments that contain no heavy metals such as lead or cadmium. And, finally, jute is spun from the fibers of jute plants in India and Bangladesh, where it is in abundant and renewable supply.

Linoleum is also naturally beneficial to indoor air quality. The product's natural bactericidal and anti-static properties reduce the presence of dust and dirt and the subsequent growth of household mites and/or bacteria. There is also no build-up of dirt-attracting static electricity. But Forbo has gone beyond this to make sure that its products are as environmental as possible, adhering to Agenda 21, a document that resulted from environmental conventions throughout the world and that centers on the role of trade and industry and devotes two chapters to critical issues such as clean production processes and responsible entrepreneurship. "At Forbo, we know our responsibilities as the world leader in linoleum," states the company's environmental brochure. "Not only must we continually lead the industry in quality and innovation we must also lead the industry on environmental issues. Assurance of the long-term sustainability of the environment is at the very core of our corporate strategy."

So, beyond using renewable and natural raw materials, Forbo has set an agenda for itself to manufacture linoleum flooring products using the most environmental processes it can. Every year since 1993 Forbo-Krommenie has issued an annual environmental report, and the company has "now reached the status of being an environmentally self-regulating company." Plus, its environmental management system is ISO 14001 certified and stipulates that "all products must be manufactured with the lowest possible environmental impact."

Forbo boasts that "12% of the total investments in our facility are directly aimed at measures to further improve our environmental performance." Life-cycle analysis also points to the product's environmental benefits – "linoleum has been known for years as the 40-year floor." Independent research has also shown linoleum's superiority among alternative flooring materials.

In 1993, Utrecht University compared the environmental effects of four types of floor coverings – linoleum, vinyl, wool carpet, and synthetic carpet. The research studied the following aspects: use of primary energy carriers such as mineral oil and gas, depletion of scarce materials, fertilization effects, acidification, smog formation, deterioration of the ozone layer, effects on global warming, and production of waste products. And the results: "Comparison shows that linoleum is clearly the best. With the exception of linoleum's contribution to the fertilization effects, it clearly yields the lowest on all effect scores."

In addition, the product's environmental credibility is evidenced by its use in building projects where green building products are required. For example, in the Environmental Protection Agency's offices in five renovated buildings, linoleum is used as a floorcovering extensively. For the selection of materials for these buildings the following guidelines had to be followed: provide a healthful working environment with exemplary indoor air quality; pursue energy-efficient design strategies including

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the incorporation of the EPA's Green Lights program; encourage conservation through the re-use, recycling, and reduction in materials use; promote the use of products, processes, and technologies with minimal global impact. Forbo is also a charter member of the U.S. Green Building Council.

### Wood

There are at least two types of wood that could be considered environmental – wood salvaged from an existing building and wood from a forest certified as sustainably harvested. And due to the increasing demand for these types of woods, there are many companies that offer both types of products.

According to salvaged wood supplier Julia Sampson of A.E. Sampson, "wood flooring in general is environmental because it is a renewable resource, and there is no offgassing." In addition, the wood offered by the company is certified from a sustainable forest. The company is in its fifth year of certification with the Forest Stewardship Council and the reason is because she feels customers are more interested in her wood because it comes from well managed forests.

Salvaged or recycled wood is environmental simply because it is reused either from an existing building that is being razed or from lumber that has already been harvested but has never been finished into building products. Currently, many companies are offering salvaged wood for use with flooring.

The environmental benefits of salvaged wood were described by Sandy Conklin of Conklin's Authentic Barnwood & Hand Hewn Beams: "First, the environmental impact is reduced as no additional trees were sacrificed for the materials. Second, the salvaged barns are usually more than 150 years old and were constructed of first generation timbers, some of the strongest you'll ever find. Finally, because the barns have endured decades of weathering, they bring a warm patina and sense of history to the newest of buildings."

### Carpet

The DuPont Carpet Reclamation™ Program is an award-winning, comprehensive program that takes back all types of used carpet and recycles it. The process begins with the removal of the used carpet and its storage in 40-cubic-yard enclosed lockable containers, located at one of 80 permanent collection sites or one of many temporary sites established for large jobs.

The containers, usually supplied by Waste Management, Inc., are then moved to a reclamation facility, usually located within the same city as the reclamation job. After enough waste material is collected to fill a 53-foot truck, it is shipped to C'Board in Thomson, GA, a company contracted to handle the initial receiving, sorting, and separating of the used carpet. C'Board then tests the face fiber and the backing to determine the type of recycling or reclamation that each piece is suitable for.

About 31% of the carpet received is nylon 6.6 broadloom, which is sent to the DuPont de-manufacturing facility in Chattanooga, TN, where the nylon is separated from the backing and sent to a DuPont facility in Ravenswood, WV, where it is mixed with other resins and black dye and becomes one of two pelletized resins called Minlon® or Nylin®.

These pellets are then molded for use in cars as air cleaner housings, fan shrouds and other parts. Over three million Fords on the road today have the equivalent of two square feet of used carpet from this program in their air cleaner housings. The non-nylon byproducts of the process are used as a soil enhancement by local nurseries.

EcoSoft carpet cushion is one product resulting from the reclamation of non-nylon

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Naturlich even offers adhesives that can be considered environmental. These include Eco-Fix for installing linoleum in commercial areas; Envirotec, a low toxic adhesive also for installing linoleum; and Bio-Shield, a water-based elastic adhesive for cork, carpets, and linoleum tile.

### Laminates

The look of wood (and many other surface finishes) can be replicated in laminate flooring, and some companies are making environmental offerings in this product category as well.

In the case of Wilsonart, the company offers a 100% post-consumer recycled plastic core in its Performance Flooring laminate. Its synthetic waterproof core is made through ProFX Core Technology.

The waterproof core is the first of its kind and, along with its double-wear layer, the product comes with an unprecedented 25-year residential wear, stain, fade and water damage warranty.

In addition, since Wilsonart Flooring is designed to be a "floating floor," it is not nailed or glued to the existing subfloor material.

Wilsonart's Performance Flooring line includes the wood look among a number of other surface finishes. Designs include six plank-format woodgrain designs – Pioneer Oak, Barnwood, Augusta Oak, Crossfire Birch, Autumn Maple, and Summ Maple. Other designs include Raw Crete and Rusted Crete, colored abstracts inspired by concrete; Bronzed Quarry and Canyon Quarry, rock designs in warm earth tones; and Sandstone and Castlerock, two stone-like designs.

Another environmental laminate is Perstorp Flooring, which put together its Environmental Quality brochure to explain how its desire to produce more environmental laminate flooring pervades its manufacturing process. The brochure states "All of our employees are trained to appreciate the effects our products and production processes have on the environment. With this in mind, many employees are involved directly in projects concerning the use of raw materials, waste separation, and waste reduction."

The company feels that the impetus behind the need to produce environmental flooring comes from the marketplace: "Consumers have begun to look at flooring purchases through new eyes. It is no longer enough to know how the product can be used, what it looks like and how much it costs. Today, consumers are equally interested in a product's environmental qualities: the type of raw materials used, the techniques applied in manufacturing and the recyclability potential."

Among the environmental efforts made by the company are avoiding tropical tree species and promoting recyclability. The flooring is made almost entirely of renewable materials. Laminate flooring is made of wood and paper bonded together by resins, and, in the case of Perstorp, the top layer is made of unbleached paper (except in certain cases where only non-chlorine bleach is used). The design paper is printed with water-based organic inks.

For the wood portion of the laminate flooring, the company never uses tropical tree species, high-grade timber or timber from virgin or old-growth forests. Instead, most of the chips used to make the board are byproducts from sawmills and the timber industry.

Other environmental aspects of the manufacturing process include the reduction of sawdust waste by 40% and the reduction of the use of packaging materials on incoming raw materials by 50%.

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## PVC Free Resilient Flooring Products

Manufacturer	Forbo	Armstrong	Amtico	Expanko	Expanko
Lines	Marmoleum	Marmorette, Linoplan, +	Stratica		
Applications	Commercial/ residential interiors	Commercial/ residential interiors	Commercial interiors	Commercial/ residential interiors	Commercial/ residential interiors
Warranty	5 year	5 year	10 year (on market for 8)	10 year	
Materials	Linoleum (linseed oil, wood, cork, rosin, limestone, pigments, jute or polyester backing)	Linoleum (linseed oil, cork, jute, natural resins)	Dupont Surlyn and ethylene copolymer	Cork	60 cork/ 40 rubber
Size	sheet 79" X 105" X 2.5mm tile 20"x20" or 13"x13" in 2.5mm & 2.0mm	18.9" X 18.9" tile in 2.5 mm or 3.2 mm	0.1" X 13-1/2" & 19" squares & 4"X39" planks	12" X 12" & 24" X 24" tiles in 3/16" and 5/16" thick other sizes by special order	
# patterns & colors	68+	32 colors	24 solids, 15 stone, 9 terrazos, 4 marble, 4 granites, 15 woods		
Finish			highly durable (golf ball surface claims outperforms lino, vinyl, marble), very stain resistant	Unfinished. Polyethylene, or Natural carnauba wax Expanko 960 water dispersion barrier, polyurethane polymer	
Adhesives: releasable, solvents, VOCs			2 part polyurethane, not solvent based, easy & costs less but need to roll	Expanko 2260 - zero VOC, water based, white acrylic latex	
Antimicrobial agent	naturally antimicrobial	naturally antimicrobial	??	cork is naturally mold resistant	cork is naturally mold resistant
Seam sealing	heat weld		??		
Surface (ADA wet & dry)			ADA	ADA	
Flammability	Class I	Class I	Class 1	Class 1	
Acoustic	ASTM 492 6dB		ISO 717 + 5 db		
Maintenance: clean & repair (procedure, schedule, chemicals)	No strip & recoat necessary if use dry maintenance system	Strip and polish	no floor dressing, clean w/ water or neutral ph cleanser	sweep & damp mop, screen & recoat polyurethane every 4-8 yrs (8-10 residential)	sweep & damp mop, screen & recoat polyure every 2-6 yrs (8-10 residential), buff and paste wax every 6-12 mos
Installation issues: surface, skills, tools, time	5# moisture test		3# or use moisture barrier one system for <=12#, another for 12#+, Western install. Monitor moisture all	Moisture <3#, Roll tiles	
Installed costs (commercial scale)	\$3-\$5	\$3.50 - 5.25	\$3.65 material cost, install ~\$1.50, total ~\$6.50/sf	\$5 un fin, \$5.50 wax, \$6.15 poly, \$6.48 mosaic (+ \$1.50 install)	
Notes					
National office	Hazleton, PA 800-842-7839	Armstrong 717-397-0611	Atlanta, GA 404-267-1900	(800) 345-6202 West Chester, PA	(800) 345-6202 West Chester, PA

## PVC Free Resilient Flooring Products

Manufacturer	Forbo	Armstrong	Amtico	Expanko	Expanko
Lines	Marmoleum	Marmorette, Linoplan, +	Stratica		
Manufacturing sites	UK			grown in Portugal manufacture in England	grown in Portugal manufacture in England
Web site	<a href="http://www.forbolinoleumna.com">www.forbolinoleumna.com</a>	<a href="http://www.armstrong.com/resilingleumna">www.armstrong.com/resilingleumna</a>	<a href="http://www.stratica.com">www.stratica.com</a>	<a href="http://www.expanko.com">www.expanko.com</a>	<a href="http://www.expanko.com">www.expanko.com</a>
Bay area rep			Ann Donkle 925-838-9490 adonkle@amtico.com	Lisa Schoichet 650-960-1395 X3	Lisa Schoichet 650-960-1395 X3
Bay area installers					
Life cycle manufacturing impact: Waste, air & water impacts, PBTs, hazardous materials, energy intensiveness			No water used, heat bonded laminate, no solvents, all manufacture waste reused. Fraunhofer Inst study claims 30% less energy than vinyl, 29% less water, 33% less global warming, 54% less acidification. Is petrochemical. Surelyn process unknown.	Cork from Portugal	Cork from Portugal
Recycled or renewable content	All but limestone is rapidly renewable (ex polyester backed)	All but limestone is rapidly renewable	none		
Recyclability/ disposal	decomposes in dump, may be compostable		theoretically recyclable, no infrastructure		
VOC / IAQ testing: AQS, BAA, CA East End, WA State (doc)	Some questions about VOC emissions (non carcinogenic)	Some questions about VOC emissions (non carcinogenic)	BAA tested for CA East End IAQ, tests on file at HBN - ask manufacturer for info		
Corporate enviro practices - ISO 9002, 14001, etc	ISO 9001 & 14001		ISO 9002 and 14001		
LCA analysis?	See web site				
Overall comments	*Pro: Low maintenance, renewable ingredients, can avoid strip & wax. *Con: Marginal 1350 on East End project.	*Pro: Renewable content, *Con: Marginal 1350 on East End project.	*Pro: Excellent in IAQ, No strip & wax *Con: completely petrochemical based with no (post consumer) recycled content or commitment to closing the loop	*Pro: renewable product, Con: unknown IAQ->	

This list is intended to provide a representative sampling of products and materials that are commercially available for a variety of applications. It is not intended to be comprehensive and in a rapidly changing market, the completeness and accuracy of this information cannot be guaranteed. Inclusion on this list does not imply endorsement by HBN of any product or manufacturer, nor any warranty of appropriateness of listed products for a particular application. Replication of this information for educational purposes is permitted with credit to HBN and the inclusion of these disclaimers. last updated 5/17/02

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## PVC Free Resilient Flooring Products

Manufacturer	Gerbert	Gerbert	Duro-design	We Cork	Wicanders
Lines	Mediterranean	Verte			EcoCork
Applications	Commercial/ residential interiors	Commercial/ residential interiors	Commercial/ residential interiors	Commercial/ residential interiors	Commercial/ residential interiors
Warranty			5 year		
Materials	Cork	Cork/MDF	Cork	Cork and MDF	
Size	300mm (11.8")X300mm or 600mm(23.6")X300mm X 4mm(5/32") tile	900 mm x 300 mm (35.43" x 11.81") X 11mm (7/16") float	12"X12"or 12"X24" tile X 4mm or 8mm, also 1/2" float	12"X12"X3/16" tile, 4"X36"X3/16" plank, 11-7/8"X35-9/16"X7/16" float	tile and float
# patterns & colors	8 natural patterns, 11 colorways	8 patterns	6 naturals, 58 colors, custom available	4 tile, 6 float	
Finish	Natural: UV-curable lacquer, matte/satin finish, Wax or unfinished avail, Color: UV curable acrylic-urethane, matte/satin	Prefinished w/UV-curable lacquer, matte/satin finish Unfinished available	unfinished	unfinished or wax or matte water based polyurethane sealer coat	
Adhesives: releasable, solvents, VOCs		PVA (Polyvinyl Acetate) adhesive in grooves		Bostik's Best, Dri-Tac6200, Chapko SafeSet 231& 31, Mapei540, Franklin811	
Antimicrobial agent	cork is naturally mold resistant	cork is naturally mold resistant	cork is naturally mold resistant	cork is naturally mold resistant	
Seam sealing					
Surface (ADA wet & dry)	ADA flat>= .6		ADA ASTM C-1028 Dry .7048, Wet .7293		
Flammability	Class B 2	Class B 2	Class II		
Acoustic	DIN 52210 - 4mm=12db	DIN 52210 -19db	FILC(impact) 53, FSTC (transmission) 67		
Maintenance: clean & repair (procedure, schedule, chemicals)	vacuum and damp mop or Taski P-44	vacuum and damp mop or Taski P-44	revarnish 2-3 yrs commercial, 5-7 residential	vacuum or damp mop with mild detergent, wax may be rewaxed, varnish may be polished (not waxed)	
Installation issues: surface, skills, tools, time	need 3# moisture	float, 3# or dampproof membrane	apply 4 coats of water based urethane	need <3# moisture for reg. float floor cango over any w/moisture barrier	
Installed costs (commercial scale)	\$5-8?		\$10-\$11/sf	\$5 - \$8 installed, depending on finish \$8-\$9 for float floor	
Notes					
National office	888-359-5466 Lancaster, PA gerbertinfo@gerbertltd.com	888-359-5466 Lancaster, PA gerbertinfo@gerbertltd.com	888-528-8518 Laval, Quebec info@durodesign.com	Stratham, NH 800-666-CORK 603-778-8558	

### PVC Free Resilient Flooring Products

Manufacturer	Gerbert	Gerbert	Duro-design	We Cork	Wicanders
Lines	Mediterranean	Verte			EcoCork
Manufacturing sites	grown and manufactured in Portugal	Europe?		grown in Portugal	
Web site	<a href="http://www.gerbertltd.com">www.gerbertltd.com</a>	<a href="http://www.gerbertltd.com">www.gerbertltd.com</a>	<a href="http://www.durodesign.com">www.durodesign.com</a>	<a href="http://www.wecork.com">www.wecork.com</a>	<a href="http://www.wicanders.com">www.wicanders.com</a>
Bay area rep	Bruce Adams 707-938-8431 bruceadams@mindspring.com	Bruce Adams 707-938-8431 bruceadams@mindspring.com	Bruce Adams 707-938-8431 bruceadams@mindspring.com	Lori Stambler Arc Inc., SF 415-541-0969 arcagents@aol.com	
Bay area installers					
Life cycle manufacturing impact: Waste, air & water impacts, PBTs, hazardous materials, energy intensiveness	Cork from Portugal			no formaldehyde in binder, MDF or adhesives	
Recycled or renewable content					
Recyclability/ disposal					
VOC / IAQ testing: AQS, BAA, CA East End, WA State (doc)					
Corporate enviro practices - ISO 9002, 14001, etc					
LCA analysis?					
Overall comments					

## PVC Free Resilient Flooring Products

Manufacturer	ToMarket	Flooring Alternatives	Flooring Alternatives	Bamboo Hardwoods	Moso
Lines	Unicork				
Applications	Commercial/ residential interiors	Commercial/ residential interiors	Commercial/ residential interiors	Commercial/ residential interiors	Commercial/ residential interiors
Warranty	10 year			25 year on prefinish	
Materials	Cork	Cork	Bamboo	Bamboo w/ PVA-C formaldehyde free glue	Bamboo
Size	12"X24"X5mm, beveled or straight edge	12"X12"X3/16" tile, 1'X3'X3/8" float		9/16" X 7.5" X 6' float or nail	
# patterns & colors	12 colors	8 naturals, 18 colors in solids, stripes or terrazo		4 colors	
Finish	1 coats of polymer (normal) or 2 coats of laquer (high traffic) finish applied after installation	unfished or water based acrylic finish		Acrylic urethane aluminum oxide finish, UV resistant. Also available unfished	
Adhesives: releasable, solvents, VOCs	Unicork contact adhesive			formaldehyde free	
Antimicrobial agent	cork is naturally mold resistant	cork is naturally mold resistant			
Seam sealing					
Surface (ADA wet & dry)	ADA - 66	non skid when wet			
Flammability	Class II				
Acoustic					
Maintenance: clean & repair (procedure, schedule, chemicals)	Damp mop with mild detergent, strip and reapply polymer coat once per year				
Installation issues: surface, skills, tools, time	need <=3# moisture, seal with 2 addtl coats of laquer and optional polymer coat				
Installed costs (commercial scale)				prefinished \$10/sf installed (add \$1 for float)	
Notes					
National office	LA, CA (800)465-4605	510-548-4914 877-639-1345	510-548-4914 877-639-1346	Seattle, WA 206-264-2414	

### PVC Free Resilient Flooring Products

Manufacturer	ToMarket	Flooring Alternatives	Flooring Alternatives	Bamboo Hardwoods	Moso
Lines	Unicork				
Manufacturing sites		grown on Sardinia off coast of Italy			
Web site	<a href="http://www.tomkt.com">www.tomkt.com</a>	<a href="http://www.flooringalternatives.com">www.flooringalternatives.com</a>	<a href="http://www.flooringalternatives.com">www.flooringalternatives.com</a>	<a href="http://www.bamboohardwoods.com/">www.bamboohardwoods.com/</a>	<a href="http://www.moso.com">www.moso.com</a>
Bay area rep	Walter Huff, Los Altos, 650-960-1395 (or Brian Richard/Patton group)	510-548-4914 877-639-1345	510-548-4914 877-639-1346	Mari Strain 510-548-4914 <a href="mailto:maristrain@hotmail.com">maristrain@hotmail.com</a>	
Bay area installers					
Life cycle manufacturing impact: Waste, air & water impacts, PBTs, hazardous materials, energy intensiveness					
Recycled or renewable content					
Recyclability/ disposal					
VOC / IAQ testing: AQS, BAA, CA East End, WA State (doc)					
Corporate enviro practices - ISO 9002, 14001, etc				ISO 9000	
LCA analysis?					
Overall comments					

## PVC Free Resilient Flooring Products

Manufacturer Lines	Freudenberg/ Nora Rubber	Freudenberg/ Nora Rubber	Freudenberg/ Nora Rubber	Freudenberg/ Nora Rubber	Dodge-Regupol
	Noramant	Noraplan	Ecoment	Ecoplan	EcoSurface
Applications	Heavy traffic	commercial interiors	Heavy traffic	Commercial interiors	Commercial interiors
Warranty	1 yr defect, 10 yr wear	1 yr defect, 5 yr wear	1 yr defect, 5 yr wear	1 yr defect, 5 yr wear	5 years
Materials	45% synthetic rubber, 45% mineral filler (clay), 5% pigments (no heavy metal), 5% pi recycle	rubber (10% natural 20% synthetic), 55% mineral filler (clay), 5% pigments (no heavy metal), 10% PI recycle	Recycled rubber -----		Recycled Tire Styrene Butadiene Rubber (SPR) and post industrial EPDM
Size	tile 100cmX100cmX3.5mm (39.37"X39.37"X.14") or 62.5X62.5X3.5 (24.6")	roll 49" X 48" X 0.8" tile 24" X 24" X 0.8"	tile 100cmX100cmX9mm (39.37" X 39.37"X.36")	roll 49" X 48" X 0.8" tile 24" X 24" X 0.8"	tile 18"X18", 36"X36" rolls 50' X 4' thickness (5/32, 1/4, 3/8")
# patterns & colors	Wide range of solid colors (incl light colors) and speckle patterns	Wide range of solid colors and speckle patterns	9 gray and tan colors with flecks	9 gray and tan colors with flecks	22 color palette, solid or speckled, custom mixes available
Finish	Vulcanized for very non porous surface -----				
Adhesives: releasable, solvents, VOCs	solvent free adhesives available	solvent free adhesives available	solvent free adhesives available	solvent free adhesives available	1 part polyurethane, meets CA reqs
Antimicrobial agent	Integral "Cleanguard" manufacturing process results in non porous surface. Claim that it reduces likelihood of microbial problems without requiring antimicrobial treatment				
Seam sealing	heat weld or cold weld	heat weld or cold weld	heat weld or cold weld	heat weld or cold weld	none
Surface (ADA wet & dry)	raised round or hammered, ADA wet or dry	Smooth ADA wet or dry	raised round or hammered, ADA wet or dry	Smooth ADA wet or dry	Smooth COF>0.9 or hammered
Flammability	Class 1 (Class A optional) -----				Meets NYC reqs?
Acoustic		Check Elastic series			
Maintenance: clean & repair (procedure, schedule, chemicals)	No seal coat required -----				Strip & seal recommended
Installation issues: surface, skills, tools, time					
Installed costs (commercial scale)	\$7/sf	\$4/sf	\$8/sf	\$3.40-\$4/sf	\$5-6 installed (\$2.35 material) no floor prep
Notes	Options: matching cove base and stair tread.	Options: ESD, elastic, cove base & stair tread.	Options: ESD protection, cove base and stair tread in custom volume	Options: ESD protection, cove base and stair tread in custom volume	Options: logo
National office	Freudenberg Bldg Systems, Lawrence, MA 1-800-332-NORA Info@Freudenberg.Com -----				Lancaster, PA 866-883-7780 srz@gerberltd.com



### PVC Free Resilient Flooring Products

Manufacturer	Freudenberg/ Nora Rubber	Freudenberg/ Nora Rubber	Freudenberg/ Nora Rubber	Freudenberg/ Nora Rubber	Dodge-Regupol
Lines	Norament	Noraplan	Ecocement	Ecoplan	EcoSurface
Manufacturing sites	Germany (warehouse in Lawrence, MA and Lake Forest Hill, CA) considering US plants				Lancaster, PA
Web site	<a href="http://www.norarubber.com">www.norarubber.com</a>				<a href="http://www.regupol.com/">www.regupol.com/</a>
Bay area rep	Brian Richards 415-716-4028 brichrds@thepattongroup.com				Bruce Adams 707-938-8431 bruceadams@mindspring.com
Bay area installers					
Life cycle manufacturing impact: Waste, air & water impacts, PBTs, hazardous materials, energy intensiveness	Transported from manufacture in Germany, unknown rubber production impacts				
Recycled or renewable content	none	none	almost 80% post industrial	almost 80% post industrial	600 series ~80% post consumer SPR
Recyclability/ disposal	Theoretically recyclable but not done at this time, 92% of post industrial waste is recycled or burned for energy				Technically but no take back program
VOC / IAQ testing: AQS, BAA, CA East End, WA State (doc)	Noraplan tested by AQS, meets WA State requirements (and 1350?), claim meet CA 1350 content screen, more products undergoing CA 1350 emissions tests				AQS Greenguard certified WA state, AQS on file at HBN - ask manufacturer
Corporate enviro practices - ISO 9002, 14001, etc	ISO 14001				
LCA analysis?					
Overall comments	*Pro: Appears to have good IAQ. State that they are planning CA 1350 CHPS test to confirm on more of product line. No strip & wax cycle. *Con: All virgin materials, 20-45% petrochemical based and no commitment to recycle the product yet		*Pro: Appears to have good IAQ. State that they are planning CA 1350 CHPS test to confirm. No strip & wax cycle. Mostly recycled content but commitment to recycle their product to close the loop would improve		*Pro: Good tested IAQ and good recycled content. Commitment to recycle would improve. *Con: Suggest strip and wax maintenance

This list is intended to provide a survey of products and materials that are commercially available for a variety of applications. In a rapidly changing market the completeness and accuracy of this information cannot be guaranteed. Inclusion on this list does not imply endorsement by HBN of any product or manufacturer, nor any warranty of the appropriateness of listed products for a particular application.

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## PVC Free Resilient Flooring Products

Manufacturer	ToMarket/DinoFlex	Mondo	Mondo	American Biltrite	Flexco
Lines	Atmosphere	Geode, Punti	Terranova	Estrie Marathon Classic	SpexTones
Applications	Commerical interiors	Commerical interiors (also have sport floor product)	Commerical interiors	Commerical interiors	Commerical interiors
Warranty	2 years	1 yr defect, 5 year wear	1 yr defect, 10 year wear	10 year	10 year
Materials	Recycled Tire SPR & virgin colored EPDM	synthetic SB rubber, mineral fillers, organic and synthetic pigments, no heavy metals	synthetic SB rubber, mineral fillers, organic and synthetic pigments, no heavy metals	SBR synthetic rubber, pigments, extenders, processing oils and fillers	Virgin synthetic rubber
Size	tile 36" X 36" X 5/32"	tile 24"X24" or roll 6'3" X 30 to 45' 2 mm thick	tile 36"X36" or 19"X19" 3 mm thick	tile 18" X 18" or 36" X 36" 3.5mm thick	tile 18"X18"X1/8" or 12"X12"X1/8"
# patterns & colors	36 speckle patterns	44 colors in organic or speckled patterns standard, custom available	15 colors standard + 40 solid colors in raised circle, custom available	21 solid colors	Black, red, gray, green with speckle colors
Finish					
Adhesives: releasable, solvents, VOCs	interlocking mats or 2 part epoxy adhesive	Mondo MP 500 water based acrylic		2 part epoxy and polyurethane adhesives or acrylic/latex	Epoxy, solvent free option
Antimicrobial agent	Claim "not promote fungal growth" coatings available	Claim inherently anti bacterial. No coatings necessary			
Seam sealing		heat weld	heat weld	heat or cold weld	
Surface (ADA wet & dry)	ADA	Smooth, seaskin, and hammered ADA (COF .69 dry .74 wet)	Slate ADA (COF .66 dry .69 wet) & raised circle	ADA compliant, 6 profiles	Hammered, textured, studs SCOF>0.60
Flammability	Class I/ Class II	Class I	Class I	ASTM E-648/NFPA 253 Class 1	Class 1
Acoustic					
Maintenance: clean & repair (procedure, schedule, chemicals)	No wax. Toski seal coat recommended for high traffic, reapply every 2-5 years	No surface coating recommended		mop and buff only, No ongoing coating	No wax
Installation issues: surface, skills, tools, time		#3 moisture	#3 moisture	suggest intial conditioner to protect during construction	
Installed costs (commercial scale)	\$3 - \$10/sf (depending on thickness and color)	\$4-\$5		\$5/sf installed (glue down, +\$1 for heat weld	\$3-4/sf
Notes	Options: logo. Young company and product	Options: logo, custom designs, stairtread. Also make sports surfaces		cove base, stair treads, risers and stringers	Reports of strong odors on internet
National office	DC 877-843-8184, LA, CA 800-465-4605	Laval, QC 450-967-5800, 800-361-3747		Mississauga, Ontario 905-507-2402 800-437-8743 flooring@american-biltrite.com	Tuscumbia, AL 800.633.3151 info@flexcofloors.com

## PVC Free Resilient Flooring Products

Manufacturer	ToMarket/DinoFlex	Mondo	Mondo	American Biltrite	Flexco
Lines	Atmosphere	Geode, Punti	Terranova	Estrie Marathon Classic	SpexTones
Manufacturing sites	Salmon Arm BC Canada, <a href="http://www.dinoflex.com">www.dinoflex.com</a>			Sherbrouke, Quebec	Tuscumbia, AL
Web site	<a href="http://www.tomkt.com">www.tomkt.com</a>	<a href="http://www.mondousa.com">www.mondousa.com</a>		<a href="http://www.american-biltrite.com/estrie/">http://www.american-biltrite.com/estrie/</a>	<a href="http://www.flexcofloors.com/">www.flexcofloors.com/</a>
Bay area rep	Walter Huff, Los Altos, 650-960-1395 (or Brian Richard/Patton group)	Garret Davelaar 800-962-5334 425-776-3242 (WA) <a href="mailto:gdavelaar@mondousa.com">gdavelaar@mondousa.com</a>		Bernie Hilton, 206-310-2134	Lori Stambler, ARC 415-541-0969 <a href="mailto:arcagents@aol.com">arcagents@aol.com</a>
Bay area installers					
Life cycle manufacturing impact: Waste, air & water impacts, PBTs, hazardous materials, energy intensiveness					RCA Rubber is the only manufacturer of sheet rubber goods in the US and feeds all the domestics - they burned the Cuyahoga River (Check Enviro Defense Scorecard)
Recycled or renewable content	up to 100% depending on color	none		primary is not color flec is recycled	none, but just coming out with new product with recycled content
Recyclability/ disposal	Technically but no take back program	Technically but no take back program		recyclable but no infrastructure, recycle scrap in house	
VOC / IAQ testing: AQS, BAA, CA East End, WA State (doc)	ORTECH tested to WA state, on file at HBN	ASTM D5116	ASTM D5116	claim "no or low VOC"	
Corporate enviro practices - ISO 9002, 14001, etc		Stated goal to eliminate hazardous chemicals in production and manufacture products that can be recycled. USGBC member			
LCA analysis?					
Overall comments	*Pro: Appears to have good IAQ but need individual VOC testing. Excellent recycled content. Appear to be committed to good corp environmental effort. *Con: Recommend Toski sealer reapply but only every few years.	*Pro: Appears to have good IAQ, HBN currently awaiting test information from manufacturer to confirm. Good corporate commitment, No strip & wax cycle. Unknown commitment to recycle. *Con: All virgin materials, petrochemical based.		*Pro: Claims good IAQ, but still awaiting test information. No strip and wax cycle. *Con: Minimal recycled content.	*Pro: no strip & wax *Con: Unknown IAQ, all virgin materials Call to check on new recycled product

## PVC Free Resilient Flooring Products

Manufacturer	Johnsonite	Johnsonite	US Rubber Recycling	US Rubber Recycling	RB Rubber
Lines	Roundel/Comfortech	Replay	SureStep Tire Tile	SureFlexx SportFloor	
Applications	Commercial interiors	Sports floors	heavy traffic entry	sport, heavy traffic	Sports & barns
Warranty	10 yr w/ 4mm, 5yr 3.175	2 year	6 years w/Surebond	2 years prorated	15 yr defect
Materials	SBR, additives & colorants	Recycled auto & truck tires in urethane	Recycled truck and bus tires	Recycled crumb rubber	Recycled tires
Size	tile 24" X 24" X 4 mm or 3.175mm	tile 24" X 24" X 9.5 mm	tiles 12"X12", 18"X18" or rolls 12" or 18" all 3/8"	tiles 2' X 2' X 3/2" or 1/2" have interlocking option	planks 4'X6" & 4'X8" custom to 8'X10', thickness 3/4", 1/2" or 3/8"
# patterns & colors	46 colors plus speckle	46 colors plus speckle	Black	Black, 15% fleck available in red, green blue, offwhite or combo	Black or black w/ 20% fleck color
Finish					
Adhesives: releasable, solvents, VOCs	1 part no VOC acrylic latex adhesive, 2 part low VOC (12g) epoxy, 2 part low VOC (15g) urethane	1 part no VOC water based acrylic latex adhesive, 2 part low VOC (15g) urethane	Surebond urethane adhesive	Dry lay interlock or Surebond urethane	
Antimicrobial agent					
Seam sealing	heat or cold weld	none			
Surface (ADA wet & dry)	Smooth & raised disk ADA	Smooth & raised disk ADA ASTM D-2047>=.8	Foot scraper pattern	Smooth	Antiskid or smooth
Flammability	Class 1 / Class A optional	not rated	Federal DOCFFI 70	ASTM E648. Radian flux <0.10 W/cm sq	
Acoustic					
Maintenance: clean & repair (procedure, schedule, chemicals)	Strip & wax	Strip & wax			
Installation issues: surface, skills, tools, time	moisture <=3#	moisture <=3#, seal with acrylic sealer			
Installed costs (commercial scale)					
Notes	Stair tread, wall base	Loose lay interlocking tiles available		Also outdoor paver (SuperFlexx red grn, blk)	
National office	Chagrin Falls, Ohio, (800) 899-8916 Waterloo, Ontario info@johnsonite.com	Chagrin Falls, Ohio, (800) 899-8916 Waterloo, Ontario info@johnsonite.com	Riverside CA 888-473-8453		McMinnville, OR 800-525-5530 info@usrubber.com

### PVC Free Resilient Flooring Products

Manufacturer	Johnsonite	Johnsonite	US Rubber Recycling	US Rubber Recycling	RB Rubber
Lines	Roundel/Comfortech	Replay	SureStep Tire Tile	SureFlexx SportFloor	
Manufacturing sites					McMinnville, OR
Web site	<a href="http://www.johnsonite.com">www.johnsonite.com</a>	<a href="http://www.johnsonite.com">www.johnsonite.com</a>	<a href="http://www.usrubber.com">www.usrubber.com</a>	<a href="http://www.usrubber.com">www.usrubber.com</a>	<a href="http://www.rbrubber.com">www.rbrubber.com</a>
Bay area rep	Sturla, Inc./Medallion Carpets, San Leandro CA 510-351-8104 Amber	Sturla, Inc./Medallion Carpets, San Leandro CA 510-351-8104 X214 John			
Bay area installers					
Life cycle manufacturing impact: Waste, air & water impacts, PBTs, hazardous materials, energy intensiveness					
Recycled or renewable content	unknown	Claim 100%?	95% recycled	95% recycled	100% recycled tires (flec?)
Recyclability/ disposal					Can regrind to produce other mats
VOC / IAQ testing: AQS, BAA, CA East End, WA State (doc)	No testing	No testing	Claim no measurable VOC* No WA state type testing	Claim no measurable VOC* No WA state type testing	
Corporate enviro practices - ISO 9002, 14001, etc					
LCA analysis?					
Overall comments	*Con: No testing of IAQ. not clear that there is any recycled content. Strip & wax	*Pro: High recycled content *Con: no claims on IAQ. Strip & wax	*Pro: High recycled content, *Con: no testing to back up emission claims	*Pro: High recycled content, *Con: no testing to back up emission claims	*Pro: High recycled content, *Con: no emission claims

## PVC Free Resilient Flooring Products

Manufacturer	Yemm & Hart	Tuflex	VINYL SHEET	VCT (Vinyl Composition Tile)
Lines	Tire Veneer	Spartus & Titan		
Applications	interior, exterior	Sports floor		
Warranty		5 year prorated		
Materials	Recycled K21Tire SPR & virgin colored EPDM	Vulcanized recycled rubber	PVC, plasticizers, stabilizers	PVC, Limestone, binders, stabilizers
Size	tile 18"X18", 36"X36", roll 30to150"X4' thickness 1/4", 3/8" & other	tile 27"X27"X3/8"		
# patterns & colors	Black and 14 speckle colors	16 patterns, Black and reds, grays, green with speckle colors		
Finish				
Adhesives: releasable, solvents, VOCs	Nordot #78H 2 part epoxy	Epoxy, solvent free option		
Antimicrobial agent				
Seam sealing				
Surface (ADA wet & dry)		Smooth 1.00 SCOF ADA		
Flammability	Class 2	Class A		
Acoustic		0.60 coeff of sound absorption		
Maintenance: clean & repair (procedure, schedule, chemicals)	Strip & seal	No wax?	strip and apply 2-4 coats of wax regularly	strip and apply 2-4 coats of wax regularly
Installation issues: surface, skills, tools, time				
Installed costs (commercial scale)			\$3.50-4.50 installed	\$1.50-2.25/sf material + \$1.50 install
Notes				
National office	Marquand, MO 573-783-5434	Tampa, FL 800-543-0390 info@tuflex.com		

## PVC Free Resilient Flooring Products

Manufacturer	Yemm & Hart	Tuflex	VINYL SHEET	VCT (Vinyl Composition Tile)
Lines	Tire Veneer	Spartus & Titan		
Manufacturing sites				
Web site	<a href="http://www.yemmhart.com">www.yemmhart.com</a>	<a href="http://www.tuflex.com">www.tuflex.com</a>		
Bay area rep				
Bay area installers				
Life cycle manufacturing impact: Waste, air & water impacts, PBTs, hazardous materials, energy intensiveness			PVC lifecycle effects, plasticizers, stabilizers. See PVC fact sheet	PVC lifecycle effects plus, mining of limestone. See PVC fact sheet
Recycled or renewable content	up to 100% post consumer	unknown	none	claim that PVC content is recycled
Recyclability/ disposal			none	none
VOC / IAQ testing: AQS, BAA, CA East End, WA State (doc)	Not tested for emissions. Definite rubber smell			
Corporate enviro practices - ISO 9002, 14001, etc				
LCA analysis?				
Overall comments	*Pro: High recycled content, *Con: no testing to back up emission claims	*Pro: Recycled content (actual amount unknown), *Con: no emission claims	See PVC fact sheet	See PVC fact sheet

from Bruce Main, Sustainable Design Services,  
HDR Architecture

Finishes Division 09

Stratica

Amtico markets this modular tile product. It is more expensive than vinyl composition tile but equal in price to full vinyl tile. I'll also attach a cost/analysis for this product.

<http://www.stratica.com/>

<http://ehpnet1.niehs.nih.gov/docs/1999/107-7/innovations-abs.html>

Fritztile

Their website is down so I've attached the closest link I could find. This is basically a modular synthetic terrazzo. Sound good in principle but I have heard that unless the sub floor is perfectly smooth it will telegraph inconsistencies.

[http://pdc.bricsnet.com/pdc/company/01/14/41/company\\_1.html?site=1](http://pdc.bricsnet.com/pdc/company/01/14/41/company_1.html?site=1)

Cork

Cork flooring is durable, it provides acoustical and thermal insulation, it cushions the foot, it is resistant to moisture damage and decay, it is fairly easy to clean, and it is harvested from trees in a sustainable manner. Though imported and thus energy-intensive to ship to North America, cork flooring is worthy of consideration for use in low-environmental-impact buildings.

Cork is the outer bark of an oak tree, *Quercus suber*, which grows in the Mediterranean. Open, savannah-like cork oak forests cover approximately 2.2 million hectares (5.4 million acres) primarily in seven countries: 30% in Portugal, 21% in Algeria, 20% in Spain, 16% in Morocco, 5% in France, and 4% each in Italy and Tunisia.

Cork derives its remarkable properties from a cellular structure of hollow, polyhedral (14-sided) cells with extremely strong, flexible cell walls that are waterproof and airtight. The cells are joined together in a honeycomb fashion producing a very low-density, compressible, yet strong, insulating material. The cork oak tree evolved this bark to provide protection against droughts, brush fires, temperature fluctuations, and other environmental conditions.

The bark is harvested on a periodic basis--typically every nine or ten years--in large slabs. The trees survive the debarking process, though they are more susceptible to injury until the protective outer bark is regenerated. A typical tree produces several hundred kilograms of cork at each harvesting and will survive for many generations. The largest cork oak in Portugal, estimated to be 200 years old, produced 1,200 kilos (2,600 lbs) of cork in 1992.

Most of the producing nations regulate how frequently cork can be harvested to minimize damage to the trees. Portugal, which produces 50% of the world's cork, has been particularly careful with this resource. The first Portuguese regulations protecting cork oak trees date to 1320, when King Dinis imposed penalties on anyone damaging his oak forests. During the 1920s and '30s, it became illegal to cut down the trees, other than for essential thinning and removal of old, nonproductive trees. Portugal has very strict regulations on the conversion of forestland to agriculture and other uses--in part because of the critical role the oak forests play in blocking the spread of desertification from the south.



After harvesting, the bark slabs are processed by cleaning, boiling, and stripping away the rough outer surface. Bottle stoppers ("corks") are punched from the best material in the slabs, leaving the slabs full of holes. This remainder scrap is ground into small granules. These granules are then mixed with a binder, molded into large blocks, then baked in specialized ovens to produce agglomerated cork products. Dodge-Regupol, Inc. produces blocks 25" x 37" x 5" thick (635 x 940 x 130 mm). There is almost no waste from the process. Variations in color of natural cork tiles usually result not from dyes or additives, but because of temperature differences experienced by the cork during baking. Most manufacturers offer cork tile in shades of light, medium, and dark, but there will always be variation from tile to tile.

Several different binders are used today for agglomerating cork. According to Don Scantling of Dodge-Regupol, urea formaldehyde binder was used in the past, but that was phased out during the 1980s and replaced with all-natural protein binders. According to Bruce Graye of Ipocork, Ltd., the world's largest producer of cork flooring, the agglomerating binder is urea melamine, which is a mix of urea formaldehyde and melamine formaldehyde. In a slightly different cork underlayment product made by Badger Cork, a polyurethane binder is used in the cork agglomeration.

For production of most cork floor tiles, blocks of agglomerated cork are sliced into sheets that are either  $\frac{3}{16}$ " (5 mm) or  $\frac{5}{16}$ " (8 mm) thick. The standard size is 300 x 300 mm (nominal 12" x 12"). Some manufacturers offer other sizes as well. A very interesting new tongue-and-groove cork flooring product is currently being introduced by Korq, Inc, the U.S. importer of Sardinian (Italy) cork products. Called Arkorq Ready Cork(TM), this product has a bottom cork layer, a middle layer of pressboard, and a top layer of decorative natural cork; it is sold in 300 x 900 mm (nominal 12" x 36") pieces.

These natural cork flooring products described above are quite different from a widely marketed cork-vinyl composite floor tile produced by Ipocork (which also produces natural cork tile). The cork-vinyl product has a vinyl (PVC) backing, a cork inner layer, and a 20-mil (0.5 mm) vinyl surface coat wear layer. Due to concerns with PVC, the natural cork flooring is preferred by environmentally concerned designers over vinyl. Most natural cork tiles are installed using adhesive by skilled flooring contractors. Most cork tile manufacturers recommend polyurethane adhesive, which should be fairly stable without offgassing after curing, but could release potentially dangerous VOCs during installation--specify high ventilation levels during installation. Korq, Inc. recommends DriTac Flooring Adhesive, which is a water-based, low-VOC, latex adhesive. After installation, the floor tiles are typically coated in place with polyurethane varnish (water-based, low-VOC polyurethane can be used) or a natural wax treatment. Alternatively, pre-finished cork tiles can be installed, which require no surface coating after installation but will be more susceptible to moisture seeping into the joints. The Ready Cork tongue-and-groove flooring tiles are described by the importer as being far easier to install by general contractors or homeowners than conventional cork tiles.

Cork tile is expensive as a flooring material. The least expensive cork tiles start at about \$1.50/ft<sup>2</sup> (\$16/m<sup>2</sup>), plus installation, and costs go up to about \$5/ft<sup>2</sup> (\$54/m<sup>2</sup>) for some products, such as Ready Cork. Typical costs for  $\frac{5}{16}$ " natural cork tile are in the range of \$3.00 - \$3.50/ft<sup>2</sup> (\$32 - \$38/m<sup>2</sup>) plus installation. Because distribution networks are generally not in place for cork tile, builders and contractors often have to order directly from the manufacturers, of which several are represented in the United States (*From Environmental Building News*)

Unicork

<http://www.tomkt.com/unicork.html>

Dodge Cork Tile

[http://www.regupol.com/resident/corktile\\_frame.html](http://www.regupol.com/resident/corktile_frame.html)

Wicanders Cork Flooring

[http://www.wicanders.com/us/wicanders/wicanders\\_comercial.html](http://www.wicanders.com/us/wicanders/wicanders_comercial.html)

Natural Cork

<http://www.naturalcork.com/>

### Recycled Rubber Modular Tile and Sheet

Manufactured from crumb rubber with a large selection of color and thicknesses. Custom colors available with small minimum quantities. The best safety flooring on the market (*coefficient of friction 1.2*). It has excellent chemical & stain resistant properties and requires no waxing for maintenance.

Dodge-Reguopol Recycled Content Rubber Tile

[http://www.regupol.com/comm/eco\\_frame.html](http://www.regupol.com/comm/eco_frame.html)

Atmosphere

[http://www.tomkt.com/atmosphere\\_index.html](http://www.tomkt.com/atmosphere_index.html)

### Cast Wood

Medera

<http://www.solidsurfaceflooring.com/>

Madera tile is a hard surface wood composite product made with patented technology that offers attractive benefits in both commercial and residential applications.. Madera® has established a new category in the hard surface flooring market—composite wood flooring tiles. Hard surface flooring is the fastest growing flooring category. Madera tile is made from a material known as Lignasil, ® a proprietary new material that is based on the concentration of wood fibre. The resulting product is a natural insulator and will actually flex with the subfloor and is guaranteed not to crack when installed and used under normal conditions.

Products made from Lignasil® embody the basic principals of sustainability. Here's why:

- Lignasil ® is a thermoset natural fibre bio-composite material.
- No trees are destroyed to supply raw materials in its manufacture.
- Raw materials to produce Lignasil® are obtained from post-industrial or post-agricultural sources.
- Lignasil® products can be re-ground and re-molded.
- Lignasil® products produce no VOC emissions.
- Manufacturing is efficient with low utility requirements.
- Lignasil® products are made from nearly 100 per cent natural fibre.
- Colours contain no-heavy metals.
- Lignasil® can be precision molded into three-dimensional products.

### **Madera commercial tile**

The Madera commercial tile line is available to the architectural and design community in 64 colours, each available in four textures. The product is suitable for a variety of commercial floor and wall tile applications.

With Madera commercial, a designer can specify a Madera tile in custom colours and textures ranging from slate to crocodile leather grain. The designer can even develop new colour blends with Madera for a specific colour scheme to suit a particular client's needs. Product performance is demonstrated in the table below.

Sustainable design and the use of natural materials in commercial spaces are growing trends in architecture and design. Madera commercial addresses this growing market by providing design solutions utilizing Lignasil®. As the product is made from 100 per cent post-industrial waste wood fibres, it is considered environmentally responsible.

Other issues such as indoor air quality (i.e. sick building syndrome) are major contributing factors in the selection of interior finishes. In this respect, Madera is ideally suited due to its zero off-gassing properties. For commercial installations, Madera is quieter than ceramic, more durable than hardwood and requires less maintenance than carpet.

### **Commercial installations**

Since 1997, Madera tile has been successfully installed in various major projects in the U.S. and Canada including: IBM, Cable & Wireless PLC, Morgan Stanley Dean Witter, Federal Deposit Insurance Corporation, Greater Bay Bank, YMCA Retirement Fund, Genentech, Ferro Corporation, Wolverine Shoes, Winstar Communications, Nissan, Lexus, Columbia Outerwear, EMI-Interscope Records, Choice Hotels, Cedar Sinai Hospital, Crescent Yachts, Eastern Michigan University, The Franklin Mint, Louisiana Pacific.

### **Wall Coverings – Cellulose Polyester**

Non-woven printed wallcoverings, for instance, offer an environmentally responsible alternative to vinyl and are composed of either natural and renewable or recyclable materials. These products use water-based inks that contain no heavy metals nor off gas harmful pollutants, are available in a variety of colors and designs, and are washable, stain repellent, light resistant, tear and abrasion resistant and easy to install.

### **INNENVIRONMENTS**

<http://www.innovationsusa.com/innvironments.html>

<http://www.muraspecna.com/ProductLines/BrewsterEnviron.html>

### **Wall Coverings - Polyolefin/Synthetic Textile**

Woven and non-woven looking wallcoverings and were developed to give the aesthetic appearance of a natural textile while adding an increased value in stain and abrasion resistance. These products are generally put up with an acrylic or paper backing. Many of these products are comprised of polyolefin yarns, which are olefin fibers made from polymers or copolymers of propylene.

<http://www.mdcwallcoverings.com>

## Wall Coverings - Fiber

Fiber wall coverings are permeable for water vapor, making them ideal for humid areas because they minimize the risk of mold formation, thereby enhancing indoor air quality. Some of these products are made by adhering color flakes to a backing of glass fiber. The color flakes are composed primarily of calcium carbonate (a mineral widely used in toothpaste), polyvinyl acetate binders (which are biodegradable) and pigments. The pigments used in the production of the color flakes are light resistant, non-toxic and free of lead, mercury, cadmium and other heavy metals. The fibers are joined with biodegradable binders, free of formaldehyde. The color flakes and glass fibers are melded with water based, non-toxic, biodegradable binders.

<http://www.muraspecna.com/brewster1.htm>

## Linoleum

Linoleum costs more than VCT but is competitive with higher-quality grades of sheet vinyl. Installed costs typically range from \$3.50 to \$3.75 per square foot. If properly installed and maintained, linoleum should last at least 30 to 40 years—and it actually gets stronger with age as the linseed oil oxidizes. At New York's Radio City Music Hall, the high-heeled Rockettes have kicked their way across the same linoleum floor for more than 25 years.

Linoleum's revival is attested by Armstrong Industries' recent purchase of the second-largest linoleum manufacturer DLW. If the market warrants it, Armstrong may ultimately use DLW's state-of-the art technology to rebuild its mothballed Lancaster plant. In any case, linoleum appears to be on its way back into the mainstream of commercial design.

<b>Composition</b>	Binders, fillers, pigments (some pigments contain heavy metals). Vinyl content is 30% maximum.	Linseed oil, cork, wood flour, pine rosins on jute backing, man-made, environmentally friendly pigments.
<b>Impact resistance (Static Load Limit)</b>	75 p.s.i.	150 p.s.i.—450 p.s.i.
<b>Disposal</b>	Non-biodegradable	Biodegradable
<b>Antistatic Properties</b>	Not antistatic	Inherently antistatic (not static dissipative). Repels dust and dirt.
<b>Hygienic Properties</b>	No antimicrobial properties	Inherently antimicrobial. Inhibits the growth of many microorganisms.
<b>VOC Emissions</b>	VOCs come from maintenance procedures.	No harmful agents.
<b>Availability</b>	Produced in U.S.	Produced in Europe. Shipped and

	Stocked in U.S.	stocked in U.S. (Lower energy requirements in manufacturing offset shipping energy.)
<b>Stain Resistance</b>	Good	Excellent
<b>Chemical Resistance</b>		
High pH solutions	Excellent	Good
Solvents	Good	Excellent
Acids	Good	Good
<b>Warranty</b>	5 years	5 years
<b>Maintenance</b>	Traditional waxing with periodic stripping and resealing.	Wet method or dry method (preferred)
<b>Initial Cost (Installed)</b>	\$1.50 (aver.)/sf	\$3.50 (aver.)/sf
<b>Maintenance Cost (per year)</b>	\$1.45/sf	\$.50/sf
<b>Costs:</b>		
Year 1	\$2.95	\$4.00
Year 2	\$4.40	\$4.50
Year 3	\$5.95	\$5.00
Year 4	\$7.45	\$5.50
Year		

Forbo Linoleum

<http://www.forbo-linoleum.com/home/index.html>

Armstrong Linoleum

[http://www.armstrong.com/commflooringna/browse\\_productcat\\_linoleum.jsp](http://www.armstrong.com/commflooringna/browse_productcat_linoleum.jsp)

### Epoxy Terrazzo

This is a very durable seamless floor covering that I will recommend over PVC but it is not without environmental damage. Bisphenol a is a component of all epoxy resins. Bisphenol A was invented in the 1930's during the search for synthetic estrogens. The first evidence of its estrogenicity came from experiments in the 1930's feeding BPA to ovariectomised rats. Bisphenol A is now deeply imbedded in

the products of modern consumer society, not just as the building block for polycarbonate plastic (from which it then leaches as the plastic ages) but also in the manufacture of epoxy resins and other plastics, including polysulfone, alkylphenolic, polyallylate, polyester-styrene, and certain polyester resins. Its uses don't end with the making of plastic. Bisphenol A has been used as an inert ingredient in pesticides (although in the US this has apparently been halted), as a fungicide, antioxidant, flame retardant, rubber chemical, and polyvinyl chloride stabilizer.

These uses create a myriad of exposures for people. Bisphenol A-based polycarbonate is used as a plastic coating for children's teeth to prevent cavities, as a coating in metal cans to prevent the metal from contact with food contents, as the plastic in food containers, refrigerator shelving, baby bottles, returnable containers for juice, milk and water, micro-wave ovenware and eating utensils.

Other exposures result from BPA's use in "films, sheets, and laminations; reinforced pipes; floorings; watermain filters; enamels and vanishes; adhesives; artificial teeth; nail polish; compact discs; electric insulators; and as parts of automobiles, certain machines, tools, electrical appliances, and office automation instruments"

BPA contamination is also widespread in the environment. For example, BPA can be measured in rivers and estuaries at concentrations that range from under 5 to over 1900 nanograms/liter. Sediment loading can also be significant, with levels ranging from under 5 to over 100  $\mu\text{g/kg}$  (ppb) BPA is quite persistent as under normal conditions in the environment it does not readily degrade

Tec

[http://www.tecspecialty.com/static/prod\\_info\\_epoxy\\_terrazzo.htm](http://www.tecspecialty.com/static/prod_info_epoxy_terrazzo.htm)

General Polymers

[http://www.generalpolymers.com/press/terrazzo\\_schools.asp](http://www.generalpolymers.com/press/terrazzo_schools.asp)

Stonhard

<http://www.stonhard.com/>



## Environmentally Preferable Purchasing Guide

# Greening Your Purchase of Carpet

Carpet is quiet, soft, slip-resistant and often quite beautiful. These qualities make it an extremely common choice as a floor covering for office space. But carpet also presents a problem for solid waste management programs around the country and contributes to concerns about poor indoor environmental quality. By considering a variety of lifecycle attributes, from the materials used to manufacture and install carpet to recycling and disposal issues, purchasers can make informed decisions about carpet options.

## Why Green Your Carpet?

### Environmental and Health Concerns

Environmental and health concerns associated with carpet include indoor air quality, toxic chemical emissions from manufacturing and disposal operations, and solid waste impacts. A variety of volatile organic compounds (VOCs) can be emitted from carpet materials. For example, 4-phenylcyclohexene has a very low odor threshold and has been associated with indoor air quality complaints following the installation of new carpet. Other compounds emitted from carpet, such as formaldehyde and styrene, can present acute or chronic health concerns under certain exposure conditions.

The manufacture and disposal by incineration of polyvinyl chloride, a common component of carpet backing, is a source of dioxin contamination in the environment. Dioxin is a potent carcinogen that is highly persistent in the environment and bioaccumulates through the food chain.

About 4 billion pounds of carpet enter the solid waste stream in the United States every year, accounting for more than 1 percent by weight and about 2 percent by volume of all municipal solid waste (MSW). Furthermore, the bulky nature of carpet

creates collection and handling problems for solid waste operations, and the variety of materials present in carpet makes it difficult to recycle. Some believe that the solution lies in manufacturing with recovered materials. A description of recycling activities in the carpet industry can be found at the Carpet and Rug Institute's Web site at [www.carpet-rug.com](http://www.carpet-rug.com).

### Lifecycle and Trade-off Issues

Significant impacts can occur throughout the life cycle of carpet, and these impacts vary with the types of materials used, the pattern of carpet use and replacement, and the options available for reuse, recycling, or disposal. An approach for evaluating the lifecycle impacts of carpet and other floor coverings is included in the Building for Environmental and Economic Sustainability (BEES) tool, which can be downloaded from [www.epa.gov/oppt/epp/bees.htm](http://www.epa.gov/oppt/epp/bees.htm). BEES includes lifecycle impact data on nylon and recycled polyethylene terephthalate (PET) carpet. General information on lifecycle analysis and its role in environmentally preferable purchasing can be found in the EPP General Training Tool at [www.epa.gov/oppt/epp/gent/](http://www.epa.gov/oppt/epp/gent/).

### What's Inside:

- All About Carpet
- Standards & Specifications
- Future Directions
- What Can You Do?
- Contacts and Resources

Produced by EPA's Environmentally Preferable Purchasing (EPP) Program, this is one in a series of purchasing guides aimed at helping procurement officials identify and purchase "greener" products and services. Check out all our EPP tools and resources at [www.epa.gov/oppt/epp](http://www.epa.gov/oppt/epp).



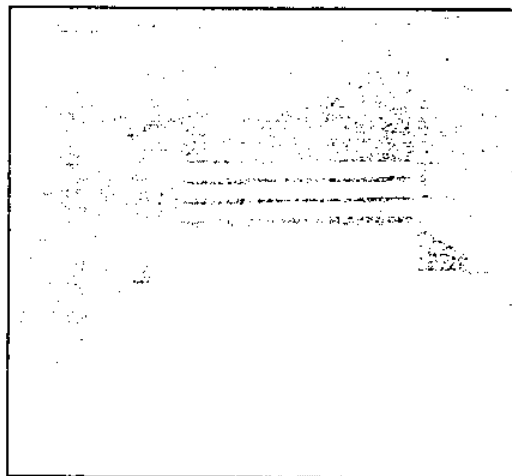
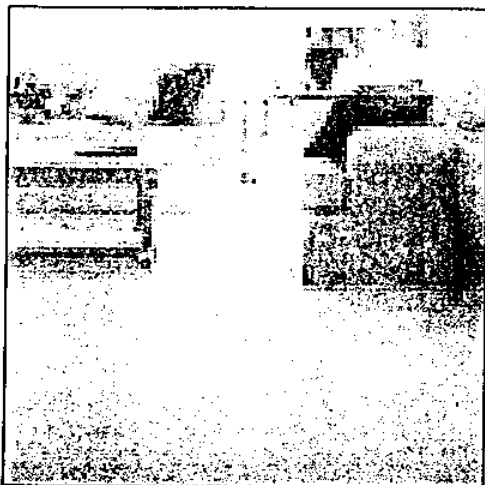
Printed on paper that contains at least 50 percent postconsumer fiber.

# All About Carpet

Nylon is the most popular fiber used in commercial carpet facing. Two closely related forms of nylon, "nylon 6" and "nylon 6,6," are used in carpet facing. Recycled nylon 6 is available and used by some manufacturers. At present, there are no commercial sources of recycled nylon 6,6. Some manufacturers believe that nylon 6,6 provides better performance for certain characteristics such as stain resistance. Polypropylene and polyester also are used in carpet face fiber. Recycled PET is widely available, but carpet made with PET face fiber is not as durable as nylon or polypropylene carpet and is usually recommended only for light- to moderate-wear conditions.

Carpet fibers may be "solution dyed" by the fiber manufacturer or dyed later at the carpet mill as the carpet is manufactured. Some believe that solution dyeing during fiber manufacture results in lower emissions and better color fastness than subsequent dyeing at the carpet mill. However, the differences between solution dyeing and mill dyeing are highly dependent on the particular processes used, and it is difficult to generalize about the advantages of one process versus the other.

Carpet backing is used to provide structural support to the face fiber. The primary materials used in carpet backing are jute, polypropylene, polyvinyl chloride (PVC), and polyurethane. Jute is a renewable bio-based product but is not as durable as the synthetic backings. Recycled-content (up to 100 percent) PVC backing is available, but dioxin and other chlorinated byproducts are formed during the manufacture and disposal (by incineration) of PVC. Polypropylene avoids the chlorinated byproduct issues of PVC, but its manufacture requires somewhat more energy than PVC does, and



recycled-content polypropylene backing is not readily available. A new polyurethane backing under development uses a polyol derived from soybean oil. In addition to the renewable resource advantage, it appears that soy-based polyurethane requires less energy during the curing step than polyurethane made from standard petroleum-based polyols.

Carpet cushion is placed underneath the carpet to provide additional comfort, insulation, and noise reduction. In some cases, the cushion is integrated with the backing. Materials commonly used in carpet cushion include polyurethane, jute, synthetic rubber, PVC, and other synthetic fibers. All of these substances can be obtained from recovered materials.

Because of its complex nature (typically at least three different materials bonded together), carpet is a difficult item to recycle. However, some manufacturers do have programs to collect used carpet for materials recovery and subsequent processing into a variety of products. Most of the carpet in the United States that is recycled is separated and processed into new products by the DuPont Carpet Reclamation Program (1-800-4DUPONT). A few other carpet manufacturers have collection programs for used carpet, and a number of manufacturers incorporate postconsumer materials in their carpet. A description of recycling activities in the carpet industry can be found at the Carpet and Rug Institute's Web site.

VOCs can be emitted from any or all carpet components, as well as from the adhesives that are sometimes used during carpet installation. Field or laboratory testing can help identify and quantify the compounds emitted. It is not possible to predict the identities and quantities of these emissions based solely on the chemical composition of the materials used in the carpet.



## Standards and Specifications

A number of states and EPA Regions have incorporated contract language that takes health and environmental considerations into account when purchasing carpet. Massachusetts state agencies specify minimum levels of recycled content for carpet purchases; both Massachusetts and Minnesota allow only low-VOC adhesives; and Washington specifies the maximum emissions allowed in the first 30 days following installation. EPA Region 7 specifications prohibit certain chemicals and require emissions to meet the Carpet and Rug Institute's "Green Label" voluntary standard (see box, next page). Region 10 allows only low-VOC and formaldehyde-free adhesives and requires that any carpet unable to be reused must be recycled with the Dupont Carpet Reclamation Program or its equivalent.

The Carpet and Rug Institute's "Green Label" program encourages manufacturers to reduce chemical emissions from carpet products. EPA also is exploring the development of voluntary consensus standards for carpet products. The standards would incorporate environmental factors into the product design and manufacturing process. In addition, under EPA's Comprehensive Procurement Guidelines (CPG), federal agencies are required to purchase carpet and carpet cushion, among other items, with recovered content. The CPG currently addresses only polyester carpet, but recent proposed changes in the CPG also address nylon carpet and nylon carpet backing, as well as including some revisions to the existing polyester carpet designation (66 FR 45256, August 28, 2001).

Purchasers can find contract language and other voluntary standards for carpet in the EPP Database at [www.epa.gov/oppt/epp/database.htm](http://www.epa.gov/oppt/epp/database.htm).

## Future Directions

The Midwestern Workgroup on Carpet Recycling was a partnership of several states, the carpet industry, and EPA that addressed concerns about the large quantity of carpet that enters the solid waste stream. EPA's participation in the Midwestern Workgroup supported the Agency's Extended Product Responsibility program, which calls on those in the product life cycle—manufacturers, retailers, users, and disposers—to share responsibility for reducing the environmental impacts of their products. The Midwestern Workgroup concluded its meetings in January 2001 with the following outcomes:

- Government partners committed to developing model procurement guidelines that address EPP in the context of carpet purchases by public entities.
- Government and the carpet industry agreed to negotiate national outcomes for the end-of-life management of carpet, including the establishment of reuse and recycling rates.
- The carpet industry agreed to create, fund, and manage a third-party organization that will be responsible for achieving the negotiated outcomes.

The National Negotiated Outcomes Group on Carpet, at [www.moea.state.mn.us/policy/carpet/](http://www.moea.state.mn.us/policy/carpet/), is a successor to the earlier Midwestern Workgroup and is developing a new Memorandum of Understanding that describes specific targets and timetables for the agreed-upon outcomes and sets the roles and responsibilities of the various signing parties, including the newly formed third-party organization named Carpet America Recovery Effort.

## Five Guiding Principles

To help government purchasers incorporate environmental considerations into purchasing decisions, EPA developed five guiding principles. The guiding principles provide a framework purchasers can use to make environmentally preferable purchases. The five principles are:

1. Include environmental considerations as part of the normal purchasing process.
2. Emphasize pollution prevention early in the purchasing process.

3. Examine multiple environmental attributes throughout a product's or service's life cycle.
4. Compare relevant environmental impacts when selecting products and services.
5. Collect and base purchasing decisions on accurate and meaningful information about environmental performance.

For more information, go to the five guiding principles on EPA's EPP Web site at [www.epa.gov/oppt/epp/fivegp.htm](http://www.epa.gov/oppt/epp/fivegp.htm).

## Carpet and Rug Institute's Green Label Emission Limits

The Carpet and Rug Institute recommends the following emission limits for carpet, cushion, and adhesive products.

### Carpet

TVOC 0.500 mg/m<sup>2</sup>hr

Styrene 0.400 mg/m<sup>2</sup>hr

4-Phenylcyclohexene 0.050 mg/m<sup>2</sup>hr

Formaldehyde 0.050 mg/m<sup>2</sup>hr

### Cushion

TVOC 0.500 mg/m<sup>2</sup>hr

Butylated hydroxytoluene (BHT) 0.400 mg/m<sup>2</sup>hr

4-PCH 0.050 mg/m<sup>2</sup>hr

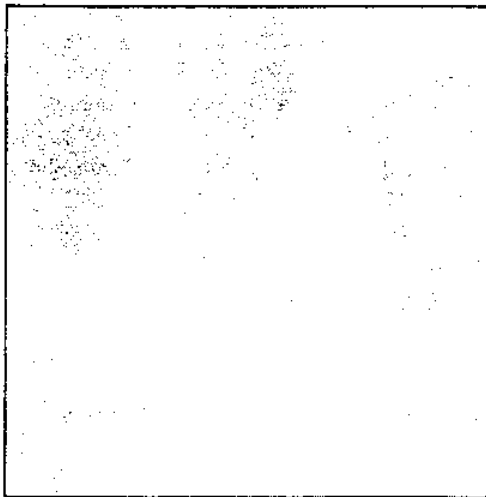
Formaldehyde 0.050 mg/m<sup>2</sup>hr

### Adhesive

TVOC 10.00 mg/m<sup>2</sup>hr

2-Ethylhexanol 3.00 mg/m<sup>2</sup>hr

Formaldehyde 0.030 mg/m<sup>2</sup>hr



## What Can You Do?

Environmentally preferable carpet choices each have their own merits, and choosing one depends on the specific need, location, and use for the carpet. Some questions to consider in determining the best choice for your situation include:

### *What are the durability requirements?*

Since increasing the durability of carpet generally requires a more resource-intensive manufacturing process and makes use of recycled material difficult, it is important to anticipate the expected use pattern and replacement schedule in order to make the best environmental purchase. For example, don't specify the most durable carpet for a temporary space with light use and frequent change in tenants and, therefore, frequent renovations and flooring replacement.

### *Tiles or broadloom?*

Tiles use more material initially because of the need for a thicker backing but, depending on the use pattern, can save materials in the long run because worn or soiled tiles can be replaced individually rather than replacing the entire carpet. Also, keep in mind that broadloom carpet comes in standard widths — typically 6 and 12 feet. Because tiles are smaller, typically less carpet is wasted when tiles are installed in spaces with different dimensions.

### *What is the recycled content of the carpet face fiber, backing, and cushion?*

### *Is there a mechanism for recycling some or all of the carpet components?*

### *What are the chemical emissions from the manufacture and disposal of carpet materials?*

### *What are the emissions from the carpet itself or from other materials used during its installation, e.g. adhesives? Do any of these emissions present indoor air quality concerns?*

## It's Policy

The federal government has undertaken various initiatives to mandate the consideration of the environment in purchasing decisions. A growing number of state and local governments also have implemented green purchasing policies or programs. In 1995, EPA established the Environmentally Preferable Purchasing (EPP) Program to encourage federal employees to consider a broad range of environmental factors, such as reduced toxicity and lower VOC content, in their purchasing decisions. In 1997, the Federal Acquisition Regulation (FAR), which provides broad purchasing guidance to federal employees, was amended to support federal procurement of green products and services. In addition, executive agencies, under Executive Order 13101, have been directed to identify and give preference to the purchase of products and services that pose fewer environmental burdens.

## Contacts and Resources

### Green Seal

<[www.greenseal.org](http://www.greenseal.org)>

Green Seal is the independent, nonprofit organization dedicated to protecting the environment by promoting the manufacture and sale of environmentally responsible consumer products. It sets environmental standards and awards a Green Seal of Approval to products that cause less harm to the environment than other similar products. The Choose Green Report on Carpets offers a list of recommended carpet brands, their manufacturers, and contacts. Green Seal's consensus Environmental Standard for Commercial Adhesive, GS-36, covers carpet adhesives. Both the report and the standard are available through Green Seal's Web site.

### Comprehensive Procurement Guidelines (CPG)

<[www.epa.gov/cpg](http://www.epa.gov/cpg)>

Designates products that can be made with recovered materials and recommends minimum recovered material content levels.

### The National Negotiated Outcomes Group on Carpet

<[www.moea.state.mn.us/policy/carpet/](http://www.moea.state.mn.us/policy/carpet/)>

Partnership of several states, the carpet industry, and EPA; addressing concerns about the large quantity of carpet that enters the solid waste stream.

### DuPont Carpet Reclamation Program (1-800-4DUPONT)

Collects and separates used carpet; processes into new products.

### Carpet and Rug Institute

<[www.carpet-rug.com](http://www.carpet-rug.com)>

General information on the carpet industry and information on the CRI Green Label program.

## EPA's Purchasing Tool Suite

EPA's EPP Program has developed the following Web-based tools to help purchasers consider the environment, along with price and performance, when buying a product or service:

**Database of Environmental Information for Products and Services** — A searchable database of product-specific information (e.g., environmental standards and guidelines or contract language) developed by government programs, both domestic and international, as well as third parties.

<[www.epa.gov/oppt/epp/database.htm](http://www.epa.gov/oppt/epp/database.htm)>

**Promising Practices Guide for Greener Contracts** — A series of short case studies highlighting successful strategies for incorporating environmental factors into a variety of product and service contracts.

<[www.epa.gov/oppt/epp/ppg](http://www.epa.gov/oppt/epp/ppg)>

**General EPP Training Tool** — Covers basic EPP principles and mandates, along with some more in-depth applications of EPP, in an entertaining and multimedia format.

<[www.epa.gov/oppt/epp/gentt/](http://www.epa.gov/oppt/epp/gentt/)>

**Tips for Buying Green with the Government Credit Card** — Tips to help government credit card holders make greener choices when buying products, such as cleaning products.

<[www.epa.gov/oppt/epp/creditcard.htm](http://www.epa.gov/oppt/epp/creditcard.htm)>

### PVC Free Carpets with recycled content

Manufacturer	Interface	Milliken	Milliken	Mohawk	Shaw Contract	Interface	Collins & Aiken
Lines	Wabi & Sabi / NexStep	Image	EarthSquare renewal process	Nature, Bayshore, Feathergrid, Structured, QuickShip, Evergreen (res)	Eco Solution/ EcoWorx	Selenium/ NexStep	PowerBond
Res / Commerical	Commerical	Commerical	Commerical	Commerical / Residential	Commerical	Commerical	
Brdlm / Modular size	20" tile	3' tile	Any modular carpet	Broadloom	Modular & 6' broadloom		
# patterns & colors		custom patterns available		lots	over 200 color options	23 patterns, 8 colors	
Carpet material	Solutia Ultron Nylon 6,6	100% Milliken Certified WearOn@ Nylon	Any modular carpet	Colorstrand Infinity Nylon 6	EcoSolution Nylon 6	Poly trimethylene terephthalate(PTT)polymer	
Carpet weave	Tufted level loop			Most woven interlock or woven felt, some tufted	Tufted		
Dye process				Solution dyed	Solution dyed		
Backing material No SB latex & 4PC	NexStep high density urethane (WARNING Sabi comes standard with recycled PVC GlasBak but can also be ordered with PVC free NexStep)	PVC-Free Comfort Plus@ cushion		None for woven. Tufted UPS Collodial emulsion No SBR latex, No 4PCH, Low VOC	EcoWorx thermoplastic polyolefin closed loop recyclable	<b>PVC BACKING DISQUALIFIES THIS CARPET</b>	<b>PVC BACKING DISQUALIFIES THIS CARPET</b>
Adhesives (releasable? VOCs?)	No VOC, releasable	No VOC, releasable	No VOC, releasable	No VOC?, releasable adhesive option, urethane backing is heat welded	Low VOC releasable Sureset N5000	No VOC, releasable	
Antimicrobial agent	Intersept integral organic lifetime antimicrobial agent	BioCare@ Built-In Protection		Topically applied Medi Guard	broad spectrum antimicrobial?	Intersept integral organic lifetime antimicrobial agent	
Moisture Impermeability & seam sealing	middle carbite adhesive also serves as moisture barrier to protect backing, polycarbite seam sealer is moisture impervious	seams sealing??, large tile means fewer seams		woven can have no backing, breathe and clean through it. UPS Bloc is impermeable, Low VOC seam sealer		middle carbite adhesive also serves as moisture barrier to protect backing, polycarbite seam sealer is moisture impervious	
Recycled content (post industrial & post consumer, potential & actual)	100% post industrial face, designed with "zipper" to release weave from backing for easy 100% recycling. Company will downcycle or repurpose old carpet. Nylon 6,6 not yet closed loop recyclable	4% recycled content, designed for EarthWise process	Can renew (reuse) about 80% of the carpet for 10 years on first reuse and about 50% of renewed carpet for 5 years on 2nd reuse for 25 to 30 year max life.	Face standard is 25% post consumer & 25% post industrial. Can do 100% PC on special order. Nylon 6 face 100% recyclable, urethane backing not. Other materials downcycle Claim 24% reduction in energy over virgin nylon	Face and backing 100% recyclable, current content about 25%in each though face can go to 100%. Unknown post consumer/post industrial mix. Hope to have 40% in backing in 2002. Ultimate goal 100%	designed with "zipper" to release weave from backing for easy 100% recycling	

### PVC Free Carpets with recycled content

Manufacturer	Interface	Milliken	Milliken	Mohawk	Shaw Contract	interface	Collins & Aiken
Lines	Wabi & Sabi / NexStep	Image	EarthSquare renewal process	Nature, Bayshore, Feathergrid, Structured, QuickShip, Evergreen (res)	Eco Solution/ EcoWorx	Solenum/ NexStep	PowerBond
CRI Green Label, WA State, VOC	CRI & WA	CRI		CRI Green label (WA state?)	CRI Green label		
Corporate environmental practices	ISO 14000 & 14001, factory is solar powered, solution dyeing uses 1/4 of the energy vs yarn dye		Apparent good corporate			Factory is solar powered, low energy dye process	
Cost factors (purchase, installation, life cycle)				\$20 - \$25/yd installed		\$27/yard installed (incl training and take back at end of life) in 99	
Notes	Corn oil product in development		Renewal process of deep cleaning, retexturing and restyling modular carpet (can be done on many non Milliken carpets) Colors get darker as they are renewed.	Claim woven has 3X life (18 yrs vs 6 yrs) of tufted, no zipper, no seam unravel, 10 yr texture retention guarantee, lifetime guarantees, not prorated	Closing of Evergreen plant may affect recycled content supply.	cross over "resilient carpet" aimed at hospital and school market, Bounce is in backing not in the weave. Rep says they are reworking, not quite ready for full use yet	
Web site	<a href="http://www.interfaceinc.com">www.interfaceinc.com</a>	<a href="http://www.milliken.com">www.milliken.com</a>	<a href="http://www.earthsquare.com/">www.earthsquare.com/</a>	<a href="http://www.infinitynylon.com">www.infinitynylon.com</a>	<a href="http://www.shawcontract.com">www.shawcontract.com</a>	<a href="http://www.solenum.com">www.solenum.com</a>	<a href="http://www.powerbond.com">www.powerbond.com</a>
National office	Atlanta, GA 770-437-6800	Spartanburg, SC 864-503-2506 Bill Gregory Government and Institutional Markets (incl healthcare) 706-880-5345	National Accounts Phone 800 -554-6637 Sam Bracken, VP Marketing, Jeff Davis, VP Sales for the flooring Kurt Hoffman, 55776 VP National Accounts - working with GPOs	Atlanta GA		Atlanta, GA 770-437-6800	

This list is intended to provide a representative sampling of products and materials that are commercially available for a variety of applications. It is not intended to be comprehensive and in a rapidly changing market, the completeness and accuracy of this information cannot be guaranteed. Inclusion on this list does not imply endorsement by HBN of any product or manufacturer, nor any warranty of the appropriateness of listed products for a particular application. Replication of this information for educational purposes is permitted with credit to HBN and the inclusion of these disclaimers.

last updated 5/17/02

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[www.healthybuilding.net](http://www.healthybuilding.net)

FR: Tom Lent

DT: 11/15/2001

RE: Review of studies of Stratica O&M costs

I recently received a study through the local Stratica rep by the Navy making the case for using Stratica instead of vinyl on an O&M cost basis. Stratica is a highly durable, recyclable (at least theoretically) non-PVC resilient flooring. The Navy did a test, first on an 800 square foot area and then on 10 ships for a total of 37,800 square feet. There calculation is as follows:

Assumptions:	Stratica	Vinyl tile
Life expectancy	10 years	5 years
Installation cost \$/sf	\$7.00	\$6.25
Repair/replacement cost \$/sf over 10 years	\$4.00	\$6.50
Cleaning/stripping/waxing labor required - manhours/ft2/year	1.07	3.31
Labor cost \$/yr @ \$15.96/hr	\$17.08	\$52.83
Total cost of ownership \$/sf over 10 years	\$181.77	\$541.85

Business Case Analysis for Maintenance Free Decking prepared by for the Under Secretary of the Navy Commander, Naval Supply Systems Command 27 December 1999

The installed Stratica price is probably a little high for healthcare new construction (probably due to special floor prep in Navy ships over metal decks). I would expect \$6.00 - \$6.50 (not including any special floor prep). The vinyl tile price looks very high to me. I would expect it to come in at less than half what the Navy report listed (\$2.50 to \$3/sf installed).

Another comparative study of commercial maintenance companies in the NYC area (Diamond Warkenthein Assoc 11/97) ignored routine daily maintenance and only looked at periodic resurfacing. They came up with much lower numbers (even accounting for the lack of daily cleaning included) of about \$4/sf/year for VCT, \$3 for sheet vinyl and \$0 for Stratica). I can't get the assumptions for this study (the firm is apparently defunct), but I have to assume they are using very low wage labor and a much lower standard of resurfacing than the Navy.

A very compelling point about the cost effectiveness of Stratica over vinyl can be made even with very conservative assumptions. Assuming that the commercial study is a better proxy than the Navy study and that the clean/strip/wax labor cost is really only \$3 to \$4 per year per square foot more for vinyl, Stratica still pays for the extra installed cost over the vinyl in the first year. This is without accounting for cleaning/stripping materials costs, IAQ issues, costs of moving occupants for stripping and waxing cycles, and earlier replacement costs.

---

As of 3/1/01 the Navy had installed 200,000 sq ft of Stratica and is rolling it out in ships and submarines.

More info about Stratica:

Amtico company web site: [www.stratica.com](http://www.stratica.com)

Environmental Building News review: [www.buildinggreen.com/products/stratica.html](http://www.buildinggreen.com/products/stratica.html)

Environmental Health Perspectives review:

<http://ehpnet1.niehs.nih.gov/docs/1999/107-7/innovations.html>

## Memorandum

**Date:** December 15, 1998

**To:** HDR Architecture  
Specification writers, Project Managers,  
Project Architects, Architects and Interior Designers

**From:** Steve Gollehon

**Subject:** Operating Room floor covering



### Introduction

I would like to share some research regarding operating suite floor covering with you. We recently performed an in depth review of floor covering options for the new Children's Hospital project. The durability, stain resistance and slip resistance properties of floor covering materials need to be reviewed with user groups to ensure that an appropriate material is specified. Hopefully you will be able to benefit from the information presented in this memorandum.

I have had the pleasure of participating in the Children's Hospital (CH) project in Omaha as the project architect for the Interior Fit-Up package. Children's new hospital building is a 265,000 square foot, nine story building with an attached 473 stall five story below grade parking garage. The total estimated construction cost is \$67.6 million. Four General, one Cardiac and one Orthopedic Operating rooms will be included in the building. The major departments included in the hospital are; Food Service, Central Supply, Radiology, Emergency, PT/OT, Outpatient Surgery, PACU, Surgery, Pediatric Intensive Care Unit (14 beds) and Med/Surg (48 beds).

### Sheet Vinyl Concerns

In investigating the floor covering systems for the Operating Rooms, we discovered that the existing sheet vinyl floor seams in the current Nebraska Methodist Hospital (NMH)/CH Operating Suite have not held up well to phenolic disinfectants. The sheet vinyl flooring was installed four or five years ago. The floors are cleaned between each case which could be 5 or 6 times daily, and at the end of each day. The floors are flooded with the disinfectant, which remains on the floor for about ten minutes, and is vacuumed up. The continued use of phenolic disinfectants has caused the welded vinyl seams to separate from the sheet vinyl. These disinfectants have been used for at least five years at NMH/CH wherever blood or body fluids are present. This type of disinfectant is used in order to kill Tuberculosis and Hepatitis viruses.

In other areas of the hospital, the more common Quaternary Ammonium Chloride is used to disinfect the floors. According to the director of Environmental Services of NMH, this chemical is only used on a daily basis and does not deteriorate the sheet vinyl floors like the Phenolic cleaners. I would suggest asking the environmental services personnel associated with your hospital projects about the type of chemicals used their on Operating room floors.

Other user concerns expressed were;

- Staff slipping and falling on wet sheet vinyl from water and fluids in the scrub areas and in the Operating rooms.



- The staining of sheet vinyl primarily from betadine. NMH spends two hours each week scrubbing the Operating room floors with an abrasive pad to remove stains.

#### Floor Covering Material Options Investigated

Sheet vinyl has been the standard floor covering material of choice in patient treatment areas for many of the projects that I have been involved with. It offers an aesthetically pleasing floor covering material with many color and pattern choices and is relatively inexpensive and can be installed by most floor covering contractors. We included sheet vinyl, epoxy aggregate and terrazzo floor systems in our investigation and analysis. We looked at the slip resistance, stain resistance, durability and life cycle cost of all three.

#### Functional Analysis of Floor Covering Materials in Operating Rooms

<i>Floor Material</i>	<i>Slip Resistance (when wet)</i>	<i>Stain Resistance</i>	<i>Durability</i>
Sheet Vinyl	Poor (1)	Average	Average
Epoxy Aggregate	Good	Good	Good (2)
Terrazzo	Poor	Average	Good

#### Notes:

- (1) Smooth sheet vinyl, Mannington is making a slip resistant sheet vinyl with texture.
- (2) Floor material will chip if sharp objects are dropped but it can be repaired.

Kiewit Construction Company, the construction manager of the project performed the life cycle cost analysis with the following results;

#### Life Cycle Cost Analysis of Floor Covering Materials in Operating Rooms

<i>Floor Material</i>	<i>Initial Cost (per sq. ft.)</i>	<i>Life Span of Material</i>	<i>Cost per Year per sq. ft.</i>
Sheet Vinyl	\$5.30	5 years (1)	\$1.06/year/s.f.
Epoxy Aggregate	\$6.00	15 years (2)	\$.40/year/s.f.
Epoxy Aggregate w/ waterproofing (3)	\$9.00	15 years	\$.60/year/s.f.
Terrazzo	\$10.00	20 years	\$.50/year/s.f.

#### Notes:

- (1) Costs do not include impact of down time due to floor covering replacement or refinishing.
- (2) Floor should be re-coated after 8-10 years.
- (3) Recommended for wet areas such as scrub, kitchen and decontamination rooms.

#### Summary of Analysis

Based on the Functional and Life Cycle Cost Analysis findings, an epoxy aggregate floor system was selected and specified for Children's Hospital for the following rooms (special rooms in bold);

Breakdown	Corridor (around Oper.	Hazardous Trash
Case Cart Assembly	Suite)	Kitchen
Cath Lab	Decontamination	Linen Handling

epoxy floor memo

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Operating Rooms  
Prep/Packing/Assembly  
Scrub Alcoves  
Soiled Holding

Staging  
Sterile Stores  
Walk-In Refrigerator and  
Freezer

Warewash

### Epoxy Aggregate Floor Installation

Epoxy aggregate floor systems can either be a broadcast or troweled application. Valspar's Quartz 6000 broadcast flooring system was specified for the majority of the rooms to receive the epoxy aggregate floor system. The following is a brief installation process for a broadcast floor;

1. Concrete floor is shot blast to remove the top layer of concrete to roughen up the surface and provide good adhesion.
2. Prepare cracks and joints.
3. Apply epoxy primer.
4. Install waterproofing membrane (recommended for wet areas such as decontam., ware wash and scrub areas).
5. Install first coat of broadcast ceramic coated quartz granules into clear epoxy resin.
6. Install second coat of broadcast ceramic coated quartz granules into clear epoxy resin.
7. The floor is then sanded to provide a coarse, medium or fine texture.
8. Install two coats of clear epoxy or urethane (operating rooms and scrub areas).

#### Notes:

1. The total system thickness (without the waterproofing membrane) will be 1/8".
2. Floor material can have an integral coved base.

As with all finish materials, having an experienced installer is critical to obtaining a good finished product. Desco Coatings, Inc. of Kansas City assisted HDR in writing the specification and arranged tours of several pharmaceutical and medical facilities. All installations visited were installed professionally and the facility owners were very pleased with the epoxy aggregate floor system. This type of flooring system can look unsightly if not installed properly. Bids for the Children's flooring will be taken sometime within the next month. Installation will occur sometime in late 1999.

I would recommend specifying an epoxy flooring system for areas within the hospital;

- Where heavy harsh chemicals are used.
- You need a waterproof floor.
- Where you need a very durable floor.
- Where stain resistance is important.
- You need a slip resistant floor.

### Additional Considerations

The Operating Room walls at Children's Hospital will have a special fiberglass reinforced epoxy wall system over an impact resistant gypsum wallboard to help keep the walls from being damaged. The interior corners of walls and wall to ceiling will also have a pre-formed inner cove (USG "SLIC") installed to help with the sanitation of the Operating Rooms.

---

**Operating Room floor covering**

**December 15, 1998**

**Page 4**

Floor patterns can be installed in the epoxy aggregate floor similar to the type of patterns that can be installed in a terrazzo floor. Extra ceramic coated quartz granules should be provided by the supplier to be kept on hand by the facility for floor patching performed in the future. As with any floor covering material color, color matching in the future can be difficult if the exact colors are not available.

Desco Coatings is arranging a lunch presentation here at HDR for sometime in mid February. I would encourage you to attend, it should be worth your time.

If you would like additional information or have questions, feel free to give me a call at X1407.

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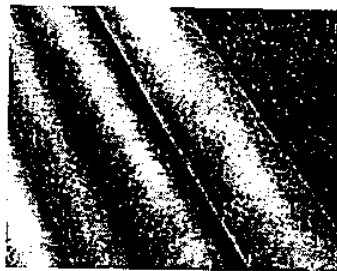


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Posted on: 09/01/2001

## Products at a Glance: Wall to Wall Sustainability

By Amy Colegrove



Innovations in

From paint and panels to glass and fabric, today's wallcoverings add color and mood to rooms while protecting the environment and indoor air quality.

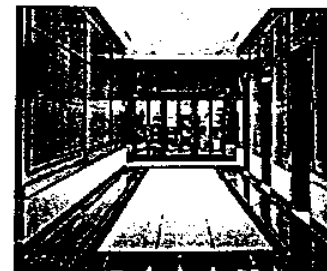
Today's wallcovering suppliers offer a broad range of products that not only enhance the color, pattern and texture of walls, but also provide the durability and environmental responsibility sought by designers in the green building industry.

Non-woven printed wallcoverings, for instance, offer an environmentally responsible alternative to vinyl and are composed of either natural and renewable or recyclable materials. These products use water-based inks that contain no heavy metals nor off gas harmful pollutants, are available in a variety of colors and designs, and are washable, stain repellent, light resistant, tear and abrasion resistant and easy to install.

Wood wallcoverings and wall trim are readily available from responsibly managed forests. Companies have even developed technology to enhance readily available logs and wood scrap to produce real wood veneer wallcovering with the appearance of figured wood, a beautiful wavy character that occurs in wind-swept trees that grow only on the edges of the world's forests.



Moment Environmenta  
Wallcovering from Roo  
International Ltd.



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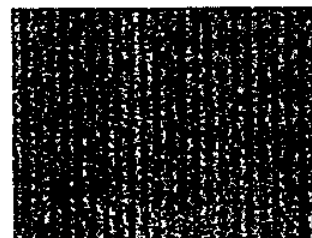
Wood paneling from  
SierraPine

Rice paper and parchment wallcoverings are made from all natural ingredients and are colored with water-based dyes. They can be used to add a soft, natural look to any room.

Fiber wallcoverings are permeable for water vapor, making them ideal for humid areas because they minimize the risk of mold formation, thereby enhancing indoor air quality. Some of these products are made by adhering color flakes to a backing of glass fiber. The color flakes are composed primarily of calcium carbonate (a mineral widely used in toothpaste), polyvinyl acetate binders (which are biodegradable) and pigments. The pigments used in the production of the color flakes are light resistant, non-toxic and free of lead, mercury, cadmium and other heavy metals. The fibers are joined with biodegradable binders, free of formaldehyde. The color flakes and glass fibers are melded with water based, non toxic, biodegradable binders.

Natural Environments from  
Muraspec N.A. (Previously  
Brewster Contract  
Wallcovering Co.)

Cork provides a durable and resilient wallcovering that does double duty as an extra layer of acoustic and thermal insulation. Cork is harvested from the bark of the cork oak tree; the trees remain standing, and the natural habitat remains undisturbed.



ProntoKorQ from KorQinc

For designers looking for fabric walls, today's textiles also offer a range of designs, high durability and environmentally responsible products. One of the more recent innovations of textiles manufacturers has been developing dying processes that use significantly less dye.

Terratex Textiles from Sina  
Pearson Textiles

"The solution dying process means that the fabrics are more color fast and can be easily cleaned," said Sina Pearson of Sina Pearson Textiles. "We have always believed that the longer a fabric lasts, which is a function of design and durability, the better for the environment."

Glass textiles are another wallcovering option gaining popularity. These wallcovering systems combine the versatility of paint, from latex to epoxy, with the strength and benefits of woven glass textile yarns made from all natural materials — sand, lime and clay. The yarns are woven into various textures and patterns and treated with a natural starch binder for dimensional stability during the hanging process. The systems are highly breathable to reduce the risk of mold and mildew; highly durable and long lasting; and can

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3/3

## WINDOWS

### Issues

By far the greatest impact doors and windows have on the environment is on the energy use during the lifespan of building operation. Windows account for between 15 percent and 30 percent of the total heating load of new houses, and up to 50 percent of the cooling loads. Cooling is the primary concern for commercial buildings. There are numerous resources that cover energy efficient design, including window placement and glazing options.

Once a building is properly sited and oriented to exclude the summer sun and encourage the winter heat, the simplest and most effective material upgrade one can make is to go to a selective glazing. By converting the ultraviolet rays to infrared as they pass through the glass, much more heat can be held inside while minimizing the fading effect on fabrics. Currently, the price is artificially higher because it's newer technology, but the manufacturer's cost is the same for glass that performs six times as well. By putting demand pressure on retailers, we can make a major step toward durability in buildings.

In the past, a primary consideration was the thermal performance of the framing materials. Now that thermal breaks are required to stop the continuous flow of heat directly to the outside, the weakest link is usually in the metal spacer bars placed between the panes of true divided lites.

### Frame Materials

#### Wood

Wood is the oldest frame material, and is the most common for residential construction. Wood has a natural warmth, is renewable, has low embodied energy, and has a reasonable thermal resistance. Windows require the highest quality wood, which is becoming increasingly scarce. No North American windows are manufactured exclusively with certified sustainably harvested wood, but some are investigating this possibility. [See Structural Materials]

The greatest concern with wood windows is overall durability and the impacts of maintenance. Newer wood windows are usually treated with fungicides to resist rot, and must be regularly be stained or painted. Without proper maintenance, the lifespan of wood windows is limited, and the deterioration will lessen energy performance. Factory finishing or cladding will last much longer and maintain color more consistently than site-applied paint. Some of these finishing processes are quite toxic, but are much better contained at the factory.

#### Engineered Wood

Engineered wood products are also being used in windows. Finger-jointed woods have a proven track record and there is growing use composite materials for non-visible components, and high quality laminated veneers over low quality cores. Caradco makes a frame with a core of Timberstrand engineered wood to produce a very dimensionally stable frame.

#### Metal

Metal windows offer high durability and low maintenance. The environmental impacts of aluminum and steel are high, but windows can be made from recycled materials. Metal windows are now required

# WINDOWS

to have a thermal break. As with wood windows, the factory finish is not only higher quality, but factory controls and efficiencies minimize waste and pollution.

## **Vinyl**

Vinyl windows are usually made from polyvinyl chloride (PVC). PVC windows are especially popular as replacement windows, offering low cost and no maintenance. The insulation performance is similar to wood, and surpasses wood when the extrusions are filled with polyurethane foam.

The manufacturing process for PVC can be quite polluting and the offgassing can be a problem for the workers. However, once installed, the offgassing is negligible. As with all plastics, there is some question about the long term performance and durability when exposed to weathering and ultraviolet (solar) radiation. Vinyl has a high coefficient of thermal expansion, and will soften at temperatures as low as 165°F. This movement over time may loosen seals and cause water and air leaks. The manufacturers' claim that plasticizers added to resist ultraviolet radiation will make vinyl windows as long-lasting as other materials, but the technology is still new and unproven. Vinyl windows have tended to discolor to a yellow over time (though mfrs. claim to have solved this). They offgas very little but are quite toxic when they burn. As with most plastics, the opportunities for recycling vinyl windows are extremely limited.

## **Composite PVC and Wood**

One relatively recent development is a replacement window made from a PVC and wood composite. A mixture of entirely post-industrial recycled wood chips and PVC is extruded into hollow frames. The composite is stronger and more stable than either of the components, the high temperature softening is not nearly the problem it is with pure PVC, and the expansion coefficient is similar to aluminum. The manufacturer [Anderson *Renewal*, 08610] is also developing an integrated manufacturing, sales, and installation process to minimize the waste created by inexperience.

## **Non-PVC Plastic**

Center Industries [08610] makes a window from over 90% recycled HDPE. At the moment, they are gearing their marketing efforts toward replacement windows for agricultural buildings.

## **Fiberglass**

Fiberglass windows are also gaining popularity. Polyester resins and glass fibers are mixed and extruded into hollow profiles. Costing less than custom wood windows, fiberglass offers the low maintenance advantages of vinyl. Fiberglass is also durable, strong and stable, with an expansion coefficient similar to glass, making it ideal for window frames. Fiberglass processing emits significant levels of air pollution, and there are concerns about the long-term effects on factory workers' health. Fiberglass is difficult to recycle, and there are no opportunities for using recycled material. Still, as their durability is proven, fiberglass windows may be a good choice.

## **Steel**

Steel windows were the standard 40 years ago and now have become a higher price choice. However, with thermal breaks, recyclability and better insulative qualities than aluminum (four times better), the future looks bright.



# WINDOWS

## Used Windows

Older windows suffer from unacceptably poor thermal performance. Check your area for companies that will refinish windows in place. Some specialize in double-glazing within the old frames. Unfortunately, there is little opportunity to recycle float glass (the wavy glass that is often found in older windows).

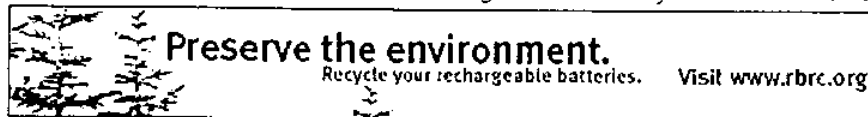
Glass block can be made with recycled content, and smaller quantities can be found in salvage yards.

## Recommendations

- Incorporate passive solar design and natural daylighting.
- Specify high quality, durable windows that won't need replacing.
- Do not reuse single-glazed windows in exterior walls of heated spaces unless the glazing can be replaced with higher performance replacement glazing (low-E, argon, etc.).
- Specify glazing appropriate to compass orientation.
- Avoid older metal windows without a thermal break.
- Avoid vinyl due to the highly polluting manufacturing process and toxicity under combustion.
- Use windows made from engineered wood products.
- Keep asking for wood windows made from environmentally certified wood.
- Use factory applied finishes for durability and air quality concerns.

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## Which Windows are the Greenest?

**Green Seal determines which windows are the most environmental and energy efficient depending on where you are building in the U.S.**

A typical U.S. house loses, on average, about 25% of its heating and cooling energy through its windows. Energy researchers have estimated that the annual energy loss through windows in the U.S. is approximately equal to the amount of energy flow through the Alaska pipeline each year. Fortunately, this energy loss could be cut in half with recent advances in glass and frame technologies and improved construction techniques.

Builders select windows for their price, availability, reliability, ease of installation or color. Most home buyers are not involved in window selection at all, other than how the frame color or style affects the overall look of a house. While economic and aesthetic factors are certainly not trivial considerations for builders and buyers, so are windows' most important functions — as insulation or as a structural barrier against the elements — are often overlooked. The result can be reduced comfort and higher costs to the occupants. Since windows last for a long time, the higher cost of energy-efficient products, as well as the selection and installation efforts, can be justified when comfort, durability and energy savings are taken into account.

## Window Basics

As windows are openings in a home's thermal envelope, they are potential conduits for conduction, convection and radiation losses. Although the basic single-pane, framed window has functioned well as an opening for light for a remarkably long time, it provides little protection against these losses.

The location of a window, as well as the house, is also important. Windows on the west and south sides of a house tend to get more sunlight. A window's ability to keep in (or reject) the sun's light and heat can be a blessing or a curse, depending on a home's location in the U.S.

## Window Construction

Most informed buyers know that a double-pane window can provide better insulation than a single-pane. Thanks to advances in glass and frame technology, there are now other methods of increasing window performance. Window designers now know how to maximize window resistance to conduction, convection and radiation losses through thermal breaks, glass treatment, better frame design and material selection. A knowledgeable builder can select the most economically and functionally appropriate windows for the house being built and can use these features to increase the salability of the home.

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### Glazing

Glazing is a window's transparent panel, which is usually glass. Windows increasingly come with glazing options beyond the doubling of glass panes. For example, filling the space between the glass panes with an inert gas such as argon instead of air can quadruple a window's insulating value compared to single-pane glass. Low-emissivity (commonly referred to as "low-E") and/or reflective coating on the glass allows light but not heat to pass through, thereby increasing owner comfort in warmer climates and reducing cooling needs.

### Frame Materials and Design

Keep in mind that glass is not the only window component. Frame material can also play an important role in energy efficiency. Wood is an excellent insulator and provides good structural rigidity for windows but typically requires more owner maintenance than other materials. Aluminum frames require less maintenance than wood and can provide the same or superior structural strength. However, aluminum frames are extremely good conductors and can be prone to indoor condensation in cold weather if a thermal break is not used to insulate outside components from inside components. Vinyl frames are comparable to wood in insulating power, require less maintenance and are not prone to condensation but generally do not have the structural rigidity or longevity of wood or aluminum. Manufacturers have also introduced composite frames that can rival wood in insulation characteristics while requiring less maintenance. Thus, proper frame selection can involve trade-offs between performance characteristics.

Better frame design has also contributed to improved window energy efficiency. Thermal breaks between glass panes and in the frame's perimeter reduce conduction through window frames. Standardized tests for air leakage have prompted manufacturers to introduce better seals and weather stripping, thereby increasing overall airtightness.

### Frame Types

As with frame materials and glass, many types of window frames are available. Their selection and quality also affect a window's heat loss characteristics, primarily through air infiltration. Unlike window glass and materials, however, the selection of frame types is a more involved process, in which function and aesthetics have more important roles.

Fixed-pane windows are airtight, inexpensive and can be custom designed for a wide variety of applications. As their name implies, however, they cannot be opened and therefore are unsuitable in places where ventilation is required. Casement and awning windows provide good ventilation when opened, and with well-designed compression seals, are moderately airtight. Windows with compression seals allow only half as much air leakage as do sliding windows with sliding seals.

Double-hung windows can be opened by pulling up the lower sash or pulling down the upper sash, but they are often leaky due to their design. Single-hung windows are somewhat less leaky because only one sash moves. Horizontal sliding windows are similar to double-hung windows except that the sashes are located on the left and right edges. These usually provide minimal ventilation and, like double-hung windows, can be quite leaky.

### Geographic Location and Orientation

The three sets of selection criteria draw on studies indicating that different climatic zones and different window orientation have different window requirements. For northern states and New England (or for north-facing windows in more temperate mixed climatic areas such as the mid-west or Atlantic regions), where heating is the largest component of a home's energy usage, it makes good economic sense to install windows that provide maximum insulation and air-tightness, while allowing the sun's heat to come through. For the south and west, or for south and west-facing

2/5

windows in mixed climates where cooling is the greatest component of a home's energy usage, it makes good economic sense to install windows that provide maximum solar heat gain protection. In hot regions, windows with selective glazing provide good solar heat control without loss of light. Darker, tinted glazings also provide lower solar heat gain coefficients, but they yield somewhat decreased outdoor visibility, particularly at night.

By carefully balancing these factors, a builder can maximize window effectiveness for a particular region and orientation while staying within budget and increasing a house's selling value. For example, because solar control is more important in hot regions or for a west- or south-facing window in a mixed-climate region, a builder can select a window with more glass area and more heat reflection but lower insulation capability. Similarly, in warmer or colder regions, occupants rely more on the heating, cooling and ventilation system rather than on windows for air circulation. Builders can choose an air-tight frame style, achieving a tighter home, and trading reduction in air leakage for less window operation.

Another way that a builder can compensate for a home's location and orientation is to install windows that are appropriate for the climatic zone but upgrade the south west facing windows in temperate and warm climates with additional glazing or treatments to counter the effects of the sun in these living spaces.

### Selecting The Right Window

A number of organizations have developed guidelines to aid in window selection. Chief among them is the National Fenestration Rating Council (NFRC) whose comprehensive ratings have done much to simplify window selection by providing "yardstick" with which consumers and builders can compare products. The NFRC goal is to level the playing field, making ratings fair and equal. The NFRC has expanded its ratings and labeling procedures, to include, in addition to U-value, the solar heat-gain coefficient, visible light transmittance coefficient and air leakage rate. It should be noted, however, that manufacturers are not required to list these additional ratings. Along with the standard U-value, manufacturers may choose to list other selection criteria. Often this is dependent on the type of window. For example, the solar heat gain coefficient is very important in sunny areas such as Florida or Texas. Therefore, this criteria will often be listed next to the U-value on windows sold in these sunnier locations.

Green Seal has developed criteria for window selection, listed below, based on a survey of existing products. The criteria identify windows best suited for cold climates as ones that can provide good insulation, low air leakage, moderate solar heat gain coefficients and good visible light transmission coefficients. Windows best suited for temperate or mixed climates are ones that can provide good to moderate insulation, low air leakage, moderate to good solar heat gain coefficients and good to moderate visible light transmission coefficients. Windows best suited for hot climates provide moderate insulation, low air leakage, good solar heat gain coefficients and moderate visible light transmission coefficients.

### Green Seal recommends that the following criteria be used for window selection:

Window Selection Criteria: What To Look For (Energy performance characteristics first)

- Heat Transfer Coefficient (also U-Value) — The lower the value, the better the insulation. Look for NFRC-certified total unit U-value, not center of glass U-value. The latter tends to be lower but is not representative of whole unit performance.
- Air Leakage Rate (ALR) — A low value indicates less leakage. The ALR is

expressed in cubic feet per minute per square foot (cfm/ft<sup>2</sup>) of window area fixed windows and cubic feet per minute per foot (cfm/ft) of window perimeter length for operable windows.

- **Solar Heat Gain Coefficient (SHGC)** — A lower value indicates less heat transmitted. Look for NFRC-certified values where available.
- **Visible Light Transmission Coefficient (VLT)** — A high value indicates more light can pass through. Look for whole window values.
- **Frame and Sash Materials** — The frame and sash should not contain heavy metals or toxic materials, such as arsenic, cadmium, lead, or mercury. They may leach into the environment through weathering or upon disposal.
- **Recycled/Recyclable Packaging** — Where possible, packaging should be made from recycled materials to reduce solid waste.

### Films

A number of manufacturers produce films that can be applied to window glass. These films can alter the glass characteristics, allowing less light or solar radiation penetrate into the living spaces. They range from tints, which reduce the amount of visible light passing through (similar to glass tinting in autos), to transparent films that can reduce solar radiation while still permitting light to pass through.

### Criteria for Selecting Films

As with windows, Green Seal has compensated for the various climate zones for the U.S. by developing two different sets of selection criteria for film.

### Construction Considerations

Windows are part of the whole house "system." As such, the selection of windows is only the first part of the energy-efficiency equation. Because windows occupy about 10 to 30% of a home's wall area on average, proper installation and sealing of windows can ensure the thermal integrity of the wall, reducing heat loss and increasing occupant comfort. Ensuring that the walls are properly insulated is another important factor. Below are discussions of ways to control air leaks, solar insulation, and condensation in order to obtain peak window performance and increase owner comfort.

### Air Leaks

Reducing or controlling air leaks requires that the window be properly installed and sealed with caulk and weatherstripping.

- **Caulking and Sealing.** Caulks are airtight compounds (usually latex or silicone) that fill cracks and holes. New caulk should be applied to all joints in the window frame and the joint between the frame and the wall. The best time to apply caulk is during dry weather when the outdoor temperature is above 45° F. Warm temperatures help the caulk to set properly and adhere to the surface.
- **Non-expanding foams.** Non-expanding aerosol foams are also now available. These foams are placed around windows, in holes and into cracks to prevent air leaks. These foams serve the same basic functions as caulking.
- **Weatherstripping.** Weatherstripping is a narrow piece of metal, vinyl, rubber

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felt, or foam that seals the contact area between the fixed and movable sections of a window joint. It should be present between the sash and the frame. Properly applied, it should not interfere with the operation of the window.

### Solar Control

Creating exterior shading using trees, shrubs or awnings is a more effective solar control method than using interior devices because they block radiation before it passes through a window. When interior shading is used, light-colored shades are preferable to dark ones because they reflect more, and absorb less, radiation. Horizontally oriented adjustable blinds are appropriate for south-facing windows, while vertically oriented adjustable blinds or other devices are more effective for shading windows on east and west orientations.

Another method for solar control, particularly in sunny climates, includes "sunscreens." These are possible components of residential packages for use in sunnier climates. They are special mesh insect screens that also modify a window's solar heat gain coefficient. These screens can be more effective than passive solar overhangs like awnings, particularly for east- and west-facing windows, because east- and west-facing windows are exposed to solar radiation when the sun is low in the sky. Durable and lasting sunscreens that can block 50% to 85% of the incoming solar radiation, but still allow light to enter, may be very cost-effective solar control measures.

In summary, even if the location of the house may not be alterable, a knowledgeable builder can counteract the site's weather and solar conditions with other means, such as shade trees, awnings, and sunscreens. These can help cool the house in warm climates or act as wind breaks in colder climates. This helps to reduce the energy required to heat or cool the house, thereby increasing its value.

### Preventing Condensation

Windows don't actually cause condensation. They are simply one of the first place it occurs. Generally, windows with low insulation values have lower thermal resistance than insulated walls, ceilings, and floors. As a result, their inside temperatures are usually lower than those of other inside surfaces during cold weather. Since warm air holds much more water than cold air, water can condense when it comes in contact with colder window surfaces. The air coming in contact with energy-efficient windows is less likely to condense because the inside surface temperatures remain higher during cold weather than do those of windows with single glazing, traditional metal spacers, and/or metal frames.

"Which Windows are the Greenest" is reprinted from Green Seal's Choose Green Special Report. Green Seal's Choose Green Reports inform end users about what products are environmentally responsible and make specific recommendations by brand, model and source. Each issue includes a discussion of the environmental importance of the topic, presents alternate products or technologies, offers criteria for product selection with rationales for them, and often includes a case history. Green Seal is an independent, nonprofit organization that awards its approval to products that cause significantly less harm to the environment than similar products. For more information, contact: Green Seal, 1730 Rhode Island Ave., NW, Washington, DC 20036-3101; 202-331-7337.

## SIDING MATERIALS

### Issues

The first responsibility of the siding is to withstand the elements. The second is to look good.

As mentioned elsewhere, it is a good idea to carefully detail the bottom edge of the siding, sealing it well, and holding it well up from grade level.

### Stucco

Stucco is a portland cement product, trowelled or shot onto a substrate of wire mesh, usually in three coats. A popular choice in the Bay Area, stucco is quite durable and fire-resistant. Because cement manufacture demands very high temperatures, stucco carries high embodied energy. Stucco is extremely permeable to moisture, and asphalt impregnated kraft papers are intentionally rated to allow some water penetration (to allow moisture in the wall to escape). After long periods of rain, moisture can begin appearing on inside wall surfaces. Stucco walls are usually painted or sealed, and need periodic maintenance and repainting.

### Exterior Insulation and Finish Systems

Exterior insulation and finish systems — EIFS — is a layered application of rigid expanded polystyrene board, fiberglass reinforcing fabric, and an acrylic finish coat, which attaches directly to concrete, masonry, stucco, sheathing, or exterior gypsum board. It is a way to add extra insulation to an existing wall, or to insulate a block wall. Since the acrylic outer skin doesn't breathe, care must be shown to avoid trapping moisture within the wall. The color is integral; so it needs no painting.

### Solid Wood

The selection of old growth softwoods like **redwood and cedar** for siding comes at a high environmental cost. Demand for these woods is a primary cause of forest destruction in the Pacific Northwest and British Columbia. Greater tolerance of the knots and sapwoods characteristic of second-growth softwoods would relieve some of the pressures on old-growth timber. Wood siding often entails waste from job-site culling of defective boards, and generates unusable scraps. It must be well maintained to avoid degradation from weathering. And it is combustible. If the material is to be painted, finger-jointed boards should be the automatic choice.

### Plywood

Plywood sidings use wood more efficiently than solid lumbers, but at an aesthetic sacrifice. They install more quickly, and are less expensive. In proper thickness, plywood siding can double as a shear panel.

### Hardboard

**Hardboard** is made from wood fibers pressed and heated into dense panels or boards. Sources of fiber include logs, sawmill wastes, post-consumer scraps, and small amounts of recycled newspaper and corrugated cardboard. Hardboards rely on the wood's natural binders for integrity, though often with

## SIDING MATERIALS

the help of small quantities of chemical additives to improve properties like hardness, stiffness, and moisture resistance. Pressed into a variety of textures and patterns, it can be purchased either unfinished, primed, or fully finished. One manufacturer, Masonite, is going through some serious performance lawsuits that call into question the lifespan of the material. The mfr. position is that the early versions of the product are different than those being sold today. Be sure to ask pointed questions about warranty and replacement.

### Fiber-cement

Fiber-cement sidings are durable — rot-, termite-, and fire-resistant. They take their fiber from smaller trees and from wood-processing waste, stabilizing it in cement. Offered in a variety of patterns and textures, fiber-cement siding comes in the form of shingles, boards, or panels. The panels have structural properties useful for adding shear values and wind resistance. The energy-intensity of cement, and the distance from manufacturing plants give fiber-cement a high embodied energy (though probably not as high as the metal sidings).

### Metal

Pre-finished metal sidings, both steel and aluminum, tend to be quite durable and maintenance-free. Though they contain high amounts of embodied energy—particularly aluminum whose production consumes enormous amounts of energy—they also tend to contain high proportions of recycled content (in most cases over 50%). Both metals impose significant environmental penalties for mineral extraction and manufacture. Both types are easily recycled.

### Wood/Plastic Composite Lumber

Wood/plastic composite lumber made from recycled plastics and recycled wood waste is more familiar as decking but is occasionally used as siding. The plastic bonds the wood fibers together and gives protection from the weather, and the wood lends dimensional stability. Although it will take paint or stain, even unfinished this material should prove quite durable.

### Vinyl

The manufacture of vinyl siding relies on petroleum, a limited resource whose extraction and processing engenders serious pollution; and produces toxic by-products in manufacture and if it ever burns. There are currently no good disposal options for vinyl siding. Vinyl, like other plastics, contains within it the potential for productive recycling.

### Earth, Masonry, and Concrete

Integral walls of earthen materials, like rammed earth and adobe, as well as those of masonry or concrete, avoid the need for siding altogether. As discussed in "Structural Materials," they can be quite durable and maintenance-free.



## ROOFING MATERIALS

### Issues

Since the roof is typically the least durable of all building components, the choice of roofing material can have a critical impact on waste. The roof takes the brunt of the weather — rain, wind, ultra-violet light, extremes of temperature, even (though rarely in the Bay Area) freeze-thaw cycles and snow. It's not uncommon for roofs to need replacing every 20 years or even sooner.

### Resource and Waste Factors

Resource and waste factors to consider among the various roofing alternatives:

- Resource depletion of virgin raw materials
- Recycled content
- Environmental impacts of extraction, manufacture, and transport, including embodied energy and embodied pollution
- Re-usability or, failing that, recyclability
- Fire-resistance
- Seismic resiliency.

The durability of a roofing material is the first criterion. Though longer-lived roofs tend to be more expensive initially, they require less frequent re-roofings. As with most other components, total life-cycle costs are better discriminators than initial costs for selecting materials.

### Design and Detailing Issues

Since keeping the roof cool can increase its life, ridge vents, ventilation baffles between the rafters, and attic ventilation indirectly save resources and reduce waste.

**A light-colored or reflective roof will absorb much less heat** (in hot climates with the aid of a radiant barrier, or even a paint-on barrier applied to the exterior surface), transmit less heat into living spaces, and last longer. This can mean smaller air-conditioning units (perhaps even eliminating the need for air-conditioning entirely), lower energy bills, and a more comfortable living space.

**Large overhangs** can help capture convection currents to aid ventilation.

*Sidebar: Researchers at the University of Southern Mississippi recently cut a school building's energy use by 21% by coating its flat roof with a reflective white elastomeric membrane<sup>1</sup>. The Florida Solar Energy Center has estimated that the 75% reflectance on a Habitat for Humanity 200 unit "cool community" neighborhood provides the energy-saving equivalent of R-19*

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<sup>1</sup> Journal of Light Construction, Dec. 95

## ROOFING MATERIALS

*insulation. A warm-climate city like Los Angeles could cut electricity use in half just by planting appropriate trees and using highly reflective roofs.*

The heavier the roof, the larger the structure needed to support it. A heavy roof generally will be more resource-intensive and may be less stable in an earthquake. Insulation requirements, though, often force the use of larger framing anyhow, although some insulation materials can achieve high levels of thermal efficiency in limited space. [see Insulation Materials]

A roof can be designed for multiple potential functions:

- Collecting of clean water for household uses and irrigation
- Harvesting sunlight for solar collectors and photovoltaic systems. (roofing tiles are being developed with photovoltaic cells built in, eliminating the usual aesthetic questions about solar panels.)
- Allowing daylight into living spaces through skylights and sunpipes.

### Sloped Roof Options

#### **Fiber-cement**

Fiber-cement roofing materials combine Portland cement with fibers, now typically from recycled or scrap wood (though until recently, from asbestos). They are lightweight, durable, and fireproof. Some of these products have experienced damage due to freeze-thaw cycles, so be sure to verify the track record. Some fiber-cement roofs come with 60-year warranties.

##### **Pros**

- relatively light-weight
- possible recycled content
- recyclable
- durable – insect and rot resistant
- fireproof

##### **Cons**

- possible freeze-thaw damage
- embodied energy from cement manufacture
- somewhat brittle
- dusty to cut

#### **Metal**

Metal roofs come in a variety of shapes and materials, from steel, copper, or aluminum panels, to metallic shingles. Steel panels, the most prevalent type, are coated with aluminum, zinc, a combination of the two, paints, or plastics. The recycled content of metal roofs can be quite high—aluminum roofing products can be as high as 98% recycled (at a fraction of the manufacturing energy of virgin aluminum). And most significantly, metal roofing is recyclable (depending on its coating). The preferred form is metal shingle because it can be repaired easily and stands a good chance of being reusable. These materials need a higher proportion of energy for manufacture than most, but the durability factor can outweigh it. **Good finish = durability:**

- Aluminized or Galvalume - 40 years
- Fluoropolymer resins - best for color finish
- Silicone-modified polyester - 20 year warranty
- Polyester resin - 7 years until fading.

## ROOFING MATERIALS

### Pros

- easily recycled
- relatively durable
- light-weight
- often high recycled content
- reflective surfaces can augment energy scheme (95% of radiant heat reflected)

### Cons

- ecological damage from mining
- good heat conductor

### Slate

Slate roofs, like clay tile, are attractive, expensive, durable, and heavy. Unlike clay, the production of slate roofing does not consume much energy, particularly if the destined site is close to the quarry. Land and water pollution have been associated with slate quarries.

The exposed side is split along the natural grain, so there is little possibility of delamination. These roofs are even more durable than clay tiles, and intact tiles can be salvaged and re-used.

### Pros

- very durable
- fireproof
- low embodied energy
- benign materials
- reusable

### Cons

- heavy, can require extra structure
- expensive
- not locally quarried in Bay Area

### Clay Tiles

Clay tiles are beautiful, fireproof, and durable (one company offers a 75-year warranty), but they're heavy and quite expensive. They are made of fired clay, normally shaped in the familiar half-cylinder, but also come in other configurations. Though clay is plentiful in most places, the manufacture of clay tiles is energy-intensive. And since they're heavy, if they're not locally manufactured transportation can add significantly to their embodied energy. Because a clay tile roof is so heavy, extra structure may be needed to support it.

### Pros

- very durable
- beautiful
- plentiful resource
- fireproof
- reusable if intact
- recyclable

### Cons

- very expensive
- extra structure
- high embodied energy
- might prove fragile in an earthquake

## ROOFING MATERIALS

### Concrete Tile

Concrete tile can substitute for clay tile but is lighter and cheaper. Made of Portland cement and sand, it can be extruded to resemble clay tiles, slate, or shake. Somewhat less durable than clay, it has high embodied energy since cement takes a great deal of energy to produce.

#### Pros

- fairly durable
- recyclable
- less expensive and lighter than clay

#### Cons

- high embodied energy
- porous — needs waterproof coating
- complex roofs can require many custom shape tiles
- heavy enough to require more structure

### Cedar Shakes

Though aesthetically appealing, cedar shakes and shingles are not good roofing options due to fire hazard and the ecological costs of the unsustainable harvesting of old-growth trees (required because of their long, straight grain). Even with the addition of fire-retardant (which itself is toxic) the hazard remains. Furthermore, shake roofs are not particularly long-lived, though oak shakes are reported to last 50 years or more.

#### Pros

- beautiful
- low embodied energy

#### Cons

- potential fire hazard
- damage to old-growth forests
- toxicity of fire retardant
- short-lived, especially considering the expense

### Asphalt Composite Shingles

Asphalt composite shingles, by far the most common roofing material for sloped roofs, consist of a fiber mat coated with asphalt and covered with mineral granules. It is both the least expensive roofing material and the shortest-lived. The mats come in two types — fiberglass (by far the more prevalent) and organic. Fiberglass mats don't carry much recycled content, (though some companies get their granules from industrial waste) but none of the resources used are considered rare. Builders dealing with freeze-thaw issues and high winds prefer organic felts. These felts often incorporate recycled cardboard or mixed paper or wood chips. Asphalt, of course, is a petroleum product-- a limited resource. Finally, production of asphalt shingles is fairly energy-intensive.

Since these roofs are so short-lived, their greatest shortcoming is the enormous disposal problem. One company in the East recycles asphalt shingles into paving materials, but no similar local options exist. Celadon and CertainTeed both recycle their production waste into paving material. Often old roofs are covered over by a new roof, but this only postpones the disposal problem (though perhaps this delay will allow for a viable recycling option by then), and because these shingles sit tight against the roof, the Asphalt Roofing Manufacturers Association recommends the extra step of a \_" air gap be created between the sheathing and shingles to keep the shingles

## ROOFING MATERIALS

from overheating. So, the best step is to select the most durable and install them carefully. Some manufacturers are coming out with new products for which they claim 40 or more years of expected life.

### Pros

- inexpensive
- some recycled content
- industry standard

### Cons

- extremely short-lived — disposal problem
- no locally available reuse or recycling options
- petroleum-based product
- high embodied energy
- VOC offgassing

### Future Options

Several promising newer technologies on the horizon:

- Plastic panels and shingles can have a high-recycled content, and may be recyclable, but questions persist regarding their durability, energy-intensity, and fossil-fuel dependence.
- Photovoltaic panels can be built into metal shingles. [see Atlantis 07320, 13980]
- Turning our mountains of discarded tires into viable roofing tiles would help solve a lingering waste problem. A few attempts at this are beginning, but at \$300 per square and lacking a Class A fire rating, it will be hard to compete. It comes with a 50-year warranty and a recommendation from Chubb Insurance to use in hail areas. [see Crowe 07320]

## Flat Roof Options

### Issues

Flat roofs, or more precisely, low-slope roofs, are more common for commercial, industrial, and multi-family buildings, although some detached houses have flat roofs. The exact amount of flat roofing is unknown; Environmental Building News' estimate of over 10 billion square feet of roofing on commercial buildings in the United States does not include industrial or institutional buildings. Commercial roofing generally has a very short lifespan, in the range of 20 years.

The most common flat roofs are built-up roofing, modified bitumen, and single ply. Together they account for about 70% of all flat roofs.

Built-up roofing, commonly referred to as tar and gravel roof, typically consists of 4 layers of roll felt adhered with hot asphalt. The final asphalt layer is embedded with stone aggregate to protect the surface from sunlight, foot traffic, and impact damage from weather and debris. The installation of built-up roofing is noticeably toxic, the strong odors during the heating and application of the hot asphalt contain numerous VOC's and particulates. a four-ply roof will typically last for 20 years. The material generally does not move well, and its lack of pliability precludes it from moving with the expansion and contraction of the building. Built-up roofing is usually adhered directly to the insulation; as such, the entire system must be removed for reroofing, greatly increasing the waste volume.

Modified bitumen roofing, sometimes called torch-down, adds either atactic polypropylene (APP) or styrene-butadiene styrene (SBS) as a polymer to the asphalt to make a more flexible membrane that uses fewer plies. Very popular in Europe, modified bitumen roofing is more flexible, adding to the lifespan. In this country there have been some concerns about the durability of modified bitumen.

In addition to the short lifespan, built-up roofs at present have limited options for recycling, and the difficulty of removing a flat roof requires landfilling not only the roofing but also the insulation, which is the greater bulk of landfill volume. In addition, there are larger environmental concerns about the pollutants released from the manufacture and installation of hot-melt built-up roofs.

Single ply roofs, a single layer of a flexible member, are made from a variety of composite materials, including ethylene propylene diene monomer (EPDM), polyvinyl chloride (PVC), chlorosulfonated polyethylene (CSPE, known by the brand name Hypalon), and polyolefin. All offer the advantages of high elasticity, easy and generally clean installation. They also suffer from serious environmental problems.

EPDM requires a ballast to meet most fire resistance requirements, and the material is susceptible to some chemicals. EPDM is also difficult to recycle.

PVC roofing raises a number of concerns, especially the potential creation of dioxin during manufacture, disposal, or fire. Dioxin is an extremely dangerous substance, and has been linked to reproductive disorders, immune suppression, and a variety of other diseases. Plasticizers added to increase flexibility include dioctyl phthalate (DEHP) a suspected endocrine disrupter.

## ROOFING MATERIALS

PVC is of particular concern during a fire, where, in addition to dioxin, hydrogen chloride gas can be released, posing a strong risk for respiratory tract damage.

CSPE has excellent weathering characteristics, but the fire resistance is provided by chlorine, which has been linked to human health ailments and stratospheric ozone depletion.

In an effort to create flat roofing materials without chlorine, some roofers have created membranes referred to as flexible polyolefin or thermoplastic olefin. These use copolymers to achieve flexibility, avoiding the risk of plasticizer leeching in PVC.

### Materials

As yet there are no ideal solutions for flat roofs. In addition to the short lifespans and disposal problems, the material is generally dark colored, greatly increasing heat absorption and increasing the cooling loads, and creating "urban heat islands", where the temperature can be as much as 8°F warmer than the surrounding countryside. Materials to offset these problems, such as PVC, have their own problematic histories.

One option to improve the nature of a flat roof is to use a protected membrane roof (PMR). In this system a waterproof membrane is applied to the structural deck, and rigid insulation is secured with ballast. A drainage layer is installed between the insulation and waterproof membrane, which allows rainwater drainage. The insulation provides protection from UV radiation, weather and temperature extremes, which will increase the roofing membranes lifespan. This system works with any type of roofing system. Care should be taken in selecting the insulation, to avoid those made with ozone depleting CFC's or HCFC's. Extruded polystyrene is the best material, and Dow Chemicals Styrofoam now uses CO<sub>2</sub> as the blowing agent. Foamglas, by Pittsburgh Corning, can also be used as the insulation, but is much more expensive and energy intensive to produce.

In addition to increasing the lifespan, this system can also reuse the insulation materials during reroofing, as the insulation can be laid loose and ballasted.

There are some new metal roofings that can now be installed on roofs with pitches as low as 1/4" per foot, typical for flat roofs. Although there is typically a higher cost, decreased maintenance and longer life make this economically and environmentally viable choice. Some metal roofing systems, such as Span-Lok by AEP-SPAN, is structural, capable of spanning 5', and eliminating the structural roof deck.

Another option for flat roofs is developing the green roof. Also called living roofs, these are actually planted with vegetation on top of a shallow soil bed, above insulation drainage layer, and waterproof membrane. American Hydrotech and Soprema are two of the major installers of green roofs. This offers the advantages of cooling, stormwater retention [see Landscape Overview Chapter], air purification, and aesthetics.

### Recommendations

- Provide high insulation
- Provide a reflective roof

## ROOFING MATERIALS

- Avoid adhesives
- Protect the membrane
- Choose durability
- Choose a roofing that can be repaired
- Avoid chlorinated hydrocarbons
- Choose recyclable materials
- Install a living roof
- Recycle old materials during reroofing.

### Issues

- Warranty
- Recycled/recyclable material
- Offgassing.

Flat roofs are more common for commercial, industrial, and multi-family buildings, although some detached houses have flat roofs. The standard technology for flat roofs has been the built-up, or tar and gravel roof, consisting of 3 or 4 layers of roll roofing stuck together with hot asphalt and covered with gravel. The many layers of roofing may seem profligate, but these roofs have proven to last and be trouble-free.

There are a number of variations of **modified single-membrane** roof. These systems are newer and are gaining acceptance among roofers.

Closed-cell **polyurethane foam** can be sprayed right over the old roof to seal up water and air leaks. Adding around R-7 per inch and increasing airtightness, this system supplements the building's energy-efficiency while it provides weather protection. Ultra-violet light harms the foam, so a protective coating, - often latex acrylic membranes or gravel - must be added. Unfortunately the polyurethane is foamed with ozone-depleting HCFC's (which are over one thousand times better than the CFC's they replaced), but the industry is working on alternatives. These roofs come with five- or ten-year warranties, although manufacturers believe the roofs to be good for 30 years or more.



## PLUMBING SYSTEMS

### Issues

Plumbing consists of three separate systems: water supply, drains, and gas. Primary considerations for each are described below.

#### *Water supply*

- Minimize total water consumption with water-conserving fixture.
- Minimize energy used to heat and pump it (for instance, use a recirculating pump).
- Use recyclable materials when possible — e.g., copper vs. PVC.

#### *Drains*

- Design so that plumbing runs are minimized.
- Provide easy, efficient access through roof for vents.
- Use metal pipe (cast iron, galvanized, or dwv copper) when possible — it can be recycled and offers better soundproofing.

#### *Gas*

- Minimize quantity of pipe by locating gas-fueled appliances close to each other.
- Select fuel-efficient appliances.

### Plumbing Demolition

Before you begin, if you are remodeling and demolishing existing plumbing, all copper, galvanized, and cast iron piping can be salvaged. If the payback isn't enough to motivate you, make it available to others who will take the time to scrap it. Old porcelain toilets can be pulverized for road base (it is not possible to reuse them as they are not low-flush). And the old toilet tank lids have value at recycling yards, where people seek out replacements for broken lids.

Old cast-iron bathtubs and pedestal sinks bring a premium in the used building materials market — care should be taken not to damage enamel surfaces during removal and transport. Sink cabinets and wall-hung sinks are also in demand at recycling yards — whenever possible divert them away from the dumpster and towards reuse.

Tub/shower valves, faucets, and brass/chrome trim are all recyclable as scrap. There are even recyclers who strip old water heaters for component parts to scrap.

## Design

The most important plumbing decisions need to be made in the initial design stage. The location of plumbing fixtures will determine efficient or excessive use of piping — location of the water heater close to sites of hot water demand will result in less heat loss in the piping and greater energy conservation, avoiding the need for a recirculating system.

### Water heaters

The choice of type of water heater needs to be made. There are several options:

- Solar — type of collector and tank storage need to be anticipated
- Electric — more economical if you have solar panel source)
- Gas — most economical in urban areas (at this point).

For additional cost, extremely efficient (95 percent as opposed to 75 percent for a standard) water heaters are available. Some can vent directly out the side wall of a building. Others are so efficient that the exhaust (combustion) air is cool enough to vent through ABS pipe.

With all hot water heaters, maintaining a lower temperature setting will prolong the life of the heater and conserve energy. Use a timer to shut down the water heater at night, and insulate the tank to at least R-16 or better.

Water heaters can be encouraged to live longer by techniques recommended in the book by Larry & Suzanne Weingarten, *The Water Heater Workbook*. Regular maintenance and replacement of the sacrificial anode can add many years of life to a tank. Plan for ease of maintenance.

### Gas water heaters

Instantaneous water heaters are more energy-efficient because they heat water on demand as it passes through, rather than maintaining a continuously heated tank of water even during low-use periods. However, timers are available to program tank water heaters to be hotter at peak use periods. The drawback to instantaneous heaters is their greater initial cost, the need for one in each bathroom or kitchen, and limits to volume that can be heated on flow-through basis.

Cold water can be preheated on its way to the water heater by using an ingenious heat exchanger that makes use of the heat going down the drain. [see WaterFilm 15000]

### Electric water heaters

Electric water heaters have the advantage of not requiring venting, as there is no combustion air. Small, undercounter electric water heaters are available for isolated fixtures.

## Water Piping

Copper water pipes have been the material of choice for many years — totally recyclable — and with lead-free solder are considered safe for drinking water.

## PLUMBING SYSTEMS

A variety of plastics — PVC, polyethylene — are approved for water piping in various jurisdictions, but are generally not recyclable and are petroleum based, leading to concerns about plastic leaching into potable water and the use of toxic solvents as well as toxic fumes when burned. There have been recent problems with joinery failure.

### ***Drains***

Cast iron and copper drainage piping are recyclable and cast iron is considered to deaden the sound of running water the most effectively.

ABS plastic drain piping is a petroleum product and highly toxic in fire, but easy to install.

Designing for ease of venting can save many fittings and feet of pipe, and minimize number of penetrations through the roof.

Designing for installation of access panels behind tub/shower valve walls can save on future waste resulting from opening the wall for inevitable future repair/replacement.

### ***Fixtures***

Selection and specifying of fixtures also happens in the design phase and attention should go to choosing water conserving, reliable, durable, easy to maintain and repair products. If no repair parts are available, a few years hence, fixtures may have to be removed and replaced. This generally means the brands with greatest name recognition. Consider using salvaged porcelain and cast iron fixtures.

Toilets are now required to be 1.5-gallon maximum flush (a 1-liter toilet is also available). The high-tech, high-maintenance air-injection valves are to be avoided. A waterless urinal is now available and can make quite a difference in water consumption. (15440)

Conventional garbage disposals create waste. To facilitate the better option of composting, the Kich'NKomposter [11450] centrifugally separates the waste from the water for you to divert into a worm box or compost before it is made toxic and of questionable safety as fertilizer (i.e. sewage sludge).

Consider a toilet tank lid that doubles as a sink: the clean tank refill water flows out a spout that you can wash your hands under, before the water drains down into the tank.

### ***Appliances***

Specify appliances that are especially water and energy conserving: though more expensive, front loading washers are much more efficient.

Design for ease of maintenance and repair in the future: installing access panels during initial construction can lessen later waste when holes might have to be cut in walls, floors, and ceilings. Follow the old plumber's adage: think about the guy who has to come behind you and repair what you are installing.



Alameda County Waste Management Authority  
Alameda County Source Reduction and Recycling Board  
[www.stopwaste.org](http://www.stopwaste.org)

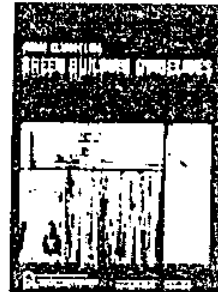
# GREEN BUILDING MATERIALS RESOURCE GUIDE

A comprehensive resource list for purchasing Green Building materials and services listed in the Residential Green Building Guidelines

Listing in this directory should not be construed as a recommendation or endorsement by the Alameda County Waste Management Authority or the Alameda County Source Reduction and Recycling Board, which is providing the information as a public service to promote the use of sustainable building materials and reduce the amount of materials landfilled. Information on products listed in this brochure is supplied by the manufacturers and has not been verified.

For more information on Green Building Guidelines or Resources, please contact:

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This listing of resources is an evolving list-the availability of materials directly correlates with the demand for them. As of current, not all of the materials listed in the Guidelines are available in the Bay Area. We are striving to change this by promoting the use of green building materials via the distribution of the Residential GreenBuilding Guidelines. Local sources will begin to stock these green building materials when they are confident that there is a consumer demand for them. Requesting your local supplier to stock the materials listed in the Guidelines is the first step in making them readily available in the Bay Area.

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9 On-Demand Hot Water Circulation Pump	18 Photovoltaics (PV)
9 Cellulose Insulation	18 Solar Hot Water Systems

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**DISMANTLING/  
DECONSTRUCTION/ SITE  
CLEANUP CONTRACTORS**

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**Beyond Waste**  
Santa Rosa, CA  
(707) 792-2555

**Bluewater Environmental Services, Inc.**  
Oakland, CA  
(510) 638-8384

**Building Resources**  
San Francisco, CA  
(415) 285-7814

**C&K Demolition & Salvage**  
Oakland, CA  
(510) 569-2070

**Caldwell Building Wrecker**  
San Francisco, CA  
(415) 550-6777

**Deconstruction Works**  
San Francisco, CA  
(415) 731-5627

**GreenWaste Recovery**  
San Jose, CA 95112  
(408) 283-4800

**Hammond Construction**  
San Pablo, CA 94806  
(510) 412-4466

**Project: Team Work**  
Pleasant Hill, CA  
(925) 974-6804

**Reusable Lumber Company**  
Mountain View, CA  
(650) 965-9138

**The Reuse People**  
San Leandro, CA  
(510) 567-8525

**Whole House Salvage**  
East Palo Alto, CA  
(650) 856-0634

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**BUILDING MATERIAL  
REUSE FACILITIES**

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**Berkeley Architectural Salvage**  
1167 65th Street  
Oakland, CA  
(510) 655-2270

**Building Resources**  
701 Amador Street  
San Francisco, CA  
(415) 285-7814

**C&K Salvage**  
718 Douglas Ave.  
Oakland, CA  
(510) 569-2070

**Caldwell Building**  
195 Bayshore Blvd.  
San Francisco, CA 94124  
(415) 550-6777

**Craftsman Home**  
3038 Claremont Ave.  
Berkeley, CA  
(510) 655-6503

**Gilman Street Salvage**  
808 Gilman Street  
Berkeley, CA  
(510) 524-5500

*Building Material Reuse Facilities  
Continued...*

**Habitat for Humanity**  
(Donations only)  
2619 Broadway  
Oakland, CA  
(510) 251-6304

**Ohmega Salvage**  
2407 San Pablo Ave.  
Berkeley, CA  
(510) 843-7368

**The Reuse People**  
2615 Davis St.  
San Leandro, CA  
(510) 567-8525

**The Sink Factory**  
2140 San Pablo Ave.  
Berkeley, CA  
(800) 540-8193

**This & That Used Building Materials**  
1701 Rumrill Blvd.  
San Pablo, CA  
(510) 232-1273

**Urban Ore**  
Folger and 7th Streets  
Berkeley, CA  
(510) 559-4450

**Whole House Salvage**  
1955 Pulgas Ave.  
East Palo Alto, CA  
(650) 856-0634

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**SUSTAINABLE WOOD  
PRODUCTS**

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Look for the Forest Stewardship Council (FSC) logo as your guarantee for sustainable, certified wood products. Sustainable, certified wood assures that the forest from which the wood comes from is managed in a way that will assure the long-term availability of the woods while protecting ancient, old growth forests. FSC is a non-profit organization with internationally recognized standards for responsible forest management.

There are several sustainable substitutes for wood such as formaldehyde free Medium Density Fiberboard (MDF), boards made from agricultural waste, such as wheatboard and riceboard. FSC particleboard as well as engineered lumber. Always call ahead for current inventory and availability. Also refer to Flooring and Decking sections.

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**PLYWOOD**

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**EUROPLY**

Manufacturer:  
**Columbia Forest Products**  
(800) 547-1791  
[www.ColumbiaForestProducts.com](http://www.ColumbiaForestProducts.com)

Distributor:  
**Weyerhaeuser**  
3945 Breakwater Court  
Hayward, CA 94545  
(510) 786-1700  
[www.eyerhaeuser.com](http://www.eyerhaeuser.com)

*Plywood Continued...*

Available at:  
**Earth Source (FSC)**  
1020 Heinz Ave.  
Berkeley, CA 94710  
(510) 549-3000  
[www.earthsourcewood.com](http://www.earthsourcewood.com)

**J.E. Higgins Hardwood Lumber Company**  
240 Littlefield Ave.  
So. San Francisco, CA 94080  
(650) 872-2163  
[www.higlum.com](http://www.higlum.com)

**Plywood and Lumber Sales (FSC)**  
4050 Horton St.  
Emeryville, CA 94608  
(510) 547-7257  
[www.pals4wood.com](http://www.pals4wood.com)

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### FRAMING LUMBER

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**Golden State Lumber (FSC)**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-100  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

**Hayward Lumber Co. (FSC Certified Trusses)**  
(Will deliver to Bay Area - call for minimums)  
429 Front St.  
Salinas, CA 93901  
(831) 775-8800  
[www.haywardlumber.com](http://www.haywardlumber.com)

**AGRIBOARD - WHEATBOARD, RICEBOARD**  
**Earth Source (FSC)**  
1020 Heinz Ave.  
Berkeley, CA 94710  
(510) 549-3000  
[www.earthsourcewood.com](http://www.earthsourcewood.com)

**Hayward Lumber Co. (FSC)**  
(Will deliver to Bay Area - call for minimums)  
429 Front St.  
Salinas, CA 93901  
(831) 775-8800  
[www.haywardlumber.com](http://www.haywardlumber.com)

### PARTICLE BOARD

Manufacturer: **Collins Company**

Distributor: **Hardwoods Inc.**  
Livermore (925) 455-5858

**Hayward Lumber Co. (FSC)**  
(Will deliver to Bay Area - call for minimums)  
429 Front St.  
Salinas, CA 93901  
(831) 775-8800  
[www.haywardlumber.com](http://www.haywardlumber.com)

**Plywood and Lumber Sales (FSC)**  
4050 Horton St.  
Emeryville, CA 94608  
(510) 547-7257  
[www.pals4wood.com](http://www.pals4wood.com)

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### DOMESTIC HARDWOODS AND SPECIALTY SOFTWOODS

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Manufacturer: **Collins Company**

Distributor: **Hardwoods Inc.**  
Livermore (925) 455-5858

Available at:  
**Earth Source (FSC)**  
1020 Heinz Ave.  
Berkeley, CA 94710  
(510) 549-3000  
[www.earthsourcewood.com](http://www.earthsourcewood.com)

*Domestic Hardwoods and Specialty Softwoods Continued...*

**Home Depot - Bay Area Wide**  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211  
Periodic stocking of a variety of certified woods

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### SALVAGED TIMBERS

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**C&K Demolition & Salvage**  
718 Douglas Ave.  
Oakland, CA 94603  
(510) 569-2070

**Caldwell Building**  
195 Bayshore Blvd.  
San Francisco, CA 94124  
(415) 550-6777

**Crossroads Recycled Lumber**  
57839 Road 225  
North Fork, CA 93643  
(888) 842-3201  
[www.crossroadslumber.com](http://www.crossroadslumber.com)

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### ENGINEERED WOOD PRODUCTS

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T11, LVL, OSB, Glu-Lam, Trusses  
Available at most lumber yards.

**TIMBERSTRAND**  
Manufacturer:  
**Trus Joist MacMillan**  
200 East Mallard Drive  
Boise, Idaho 83706  
(208) 364-0515  
[www.tjm.com](http://www.tjm.com)

Distributor: **Weyerhaeuser**  
3495 Breakwater Ct.  
Hayward, CA 94545  
(510) 786-1700  
[www.trusjoist.com](http://www.trusjoist.com)

Available at:  
**Economy Lumber**  
750 High St.  
Oakland, CA  
(510) 261-1600

**Golden State Lumber (FSC)**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-100  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

**Hayward Lumber Co. (FSC Trusses)**  
(Will deliver to Bay Area - call for minimums)  
429 Front St.  
Salinas, CA 93901  
(831) 775-8800  
[www.haywardlumber.com](http://www.haywardlumber.com)

**Home Depot - Bay Area Wide**  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211

Manufacturer:  
**Standard Structures(FSC Glu-Lam)**  
PO Box K  
Santa Rosa, CA 95402  
(800) 862-4936  
[www.standardstructures.com](http://www.standardstructures.com)

Available at:  
**Truitt and White Lumber Co.**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)

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## MEDIUM DENSITY FIBERBOARD(MDF)

Formaldehyde-Free

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### MEDITE II AND MEDEX

Manufacturer: **SierraPine Ltd.**  
(800) 676-3339  
[www.sierrapine.com/products/mdf/mdf\\_mediteII.htm](http://www.sierrapine.com/products/mdf/mdf_mediteII.htm)

Available At:  
**Hayward Lumber Co.**  
(Will deliver to Bay Area, call for minimums)  
429 Front St.  
Salinas, CA 93901  
(831) 775-8800  
[www.haywardlumber.com](http://www.haywardlumber.com)

**Plywood and Lumber Sales**  
4050 Horton St.  
Emeryville, CA 94608  
(510) 547-7257  
[www.pals4wood.com](http://www.pals4wood.com)

**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)

**Weyerhaeuser**  
(Wholesale Distributor only)  
3495 Breakwater Court  
Hayward, CA 94545  
(510) 786-1700  
[www.weyerhaeuser.com](http://www.weyerhaeuser.com)

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## TREATED WOOD

### ACQ PRESERVE

Manufacturer:  
**Chemical Specialties Inc.**  
(800) 421-8661  
[www.treatedwood.com](http://www.treatedwood.com)

Distributor:  
**J.H. Baxter**  
1700 South El Camino Real  
San Mateo, CA 94402  
(650) 349-0201

Available at:  
**Golden State Lumber**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-100  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

**Hayward Lumber Co.**  
(Will deliver to Bay Area - call for minimums)  
429 Front St.  
Salinas, CA 93901  
(831) 775-8800  
[www.haywardlumber.com](http://www.haywardlumber.com)

**M & M Building Supplies**  
8010 E 11th St.  
Tracy, CA 95376  
(209) 833-1093

**Plywood and Lumber Sales**  
4050 Horton St.  
Emeryville, CA 94608  
(510) 547-7257  
[www.pals4wood.com](http://www.pals4wood.com)

*Treated Wood Continued...*

**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)

### WOLMANIZED NATURAL SELECT WOOD

Manufacturer:  
**Hickson Arch Wood Protection**  
(770) 801-6600  
[www.wolmanizedwood.com](http://www.wolmanizedwood.com)

Available at:  
**Home Depot - Bay Area Wide**  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211

**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)

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## FIBER-CEMENT SIDING AND ROOFING

### HARDI PLANK/HARDIPANEL

Manufacturer:  
**James Hardie Building Products**  
(888) JHARDIE  
[www.jameshardie.com](http://www.jameshardie.com)

Available at:  
**Bay Area Lumber Wholesale**  
3862 Depot Rd.  
Hayward, CA 94545  
(510) 783-8500

**Golden State Lumber**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-1000  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

**Home Depot**  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211  
(Limited Stock)

**Piedmont Lumber Co.**  
351 40th St.  
Oakland, CA 94609  
(510) 658-1826

**Piedmont Wholesale**  
2120 Piedmont Way  
Pittsburg, CA 94565  
(925) 431-1100

**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)

### MAXIPLANK/MAXIPANEL

Manufacturer:  
**Maxitile, Inc.**  
(800) 338-8453

Available at:  
**ABC Supply Company, Inc.**  
7217 San Leandro St.  
Oakland, CA 94621  
(510) 430-8200

**Ashby Lumber**  
824 Ashby Ave.  
Berkeley, CA 94710  
(510) 843-4832  
(can special order)

*Fiber-Cement Siding and  
Roofing Continued...*

**Golden State Lumber**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-1000  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)  
(can special order)

**Pacific Supply**  
1735 24th St.  
Oakland, CA 94608  
(510) 832-5734  
[www.paccoast.com](http://www.paccoast.com)

**WEATHERBOARDS**  
Manufacturer:  
**Certaainteed Corporation**  
(800) 233-8990  
[www.certaainteed.com](http://www.certaainteed.com)

Available at:  
**Ashby Lumber**  
824 Ashby Ave.  
Berkeley, CA 94710  
(510) 843-4832

**Hayward Lumber Co.**  
(Will deliver to Bay Area - call for  
minimums)  
429 Front St.  
Salinas, CA 93901  
(831) 775-8800  
[www.haywardlumber.com](http://www.haywardlumber.com)

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## **TANKLESS HOT WATER HEATERS**

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**AQUA STAR, ARISTON, AND  
POWERSTREAM**  
Manufacturer:  
**Controlled Energy Corporation**  
(800) 642-3199  
[www.controlledenergy.com](http://www.controlledenergy.com)

Available at:  
**Controlled Energy Corporation**  
(Mail Order)  
Waitsfield, VT  
(800) 642-3199  
[www.controlledenergy.com](http://www.controlledenergy.com)

**Low Energy Systems** (Mail order)  
Englewood, CO 80110  
(800) 873-3507  
[www.tanklesswaterheaters.com](http://www.tanklesswaterheaters.com)

**Moran Supply**  
415 40th St.  
Oakland, CA 94609  
(510) 652-7437  
[www.moransupply.com](http://www.moransupply.com)

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## **PALOMA TANKLESS HOT WATER HEATER**

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Manufacturer:  
**Paloma Industries, Inc.**  
Oxnard, CA  
(800) 873-3507  
[www.palomaindustries.com](http://www.palomaindustries.com)

Available at:  
**Low Energy Systems** (Mail order)  
Englewood, CO 80110  
(800) 873-3507

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## **TAKAGI FLASH T-K1 AND T-M1**

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Manufacturer:  
**Takagi Industrial Co. USA**  
(888) 882-5244  
[www.takagi-usa.com](http://www.takagi-usa.com)

NorthernCalifornia Distributor:  
**Peterson Sales**  
(916) 721-3123

*Tankless Hot Water  
Heaters Continued...*

Available at:  
**Cal Steam**  
1472 66th St.  
Emeryville, CA 94608  
(510) 594-0400

**Moran Supply**  
415 40th St.  
Oakland, CA 94609  
(510) 652-7437  
[www.moransupply.com](http://www.moransupply.com)

**Tankless Water Heaters**  
2354 Taraval St.  
San Francisco, CA  
(415) 753-8400  
[www.tanklesswaterheaters.com](http://www.tanklesswaterheaters.com)

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## **ON-DEMAND HOT WATER CIRCULATION PUMP**

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**METLUND HOT WATER  
DEMAND SYSTEM**  
Manufacturer:  
**Advanced Conservation Technology**  
(800) 638-5863  
[www.metlund.com](http://www.metlund.com)

Northern CA Representative:  
**Bob Gillie**  
(916) 799-2624

Available at:  
**Cal Steam**  
1472 66th St.  
Emeryville, CA 94608  
(510) 594-0400

**Home Depot**  
(call to verify in stock)  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211

**Moran Supply**  
415 40th St.  
Oakland, CA 94609  
(510) 652-7437  
[www.moransupply.com](http://www.moransupply.com)

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## **CELLULOSE INSULATION**

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**GREENSTONE-COCOON**  
Manufacturer:  
**GreenFiber**  
(888) 592-7648  
[www.greenstone.com](http://www.greenstone.com)

Available at:  
**Golden State Lumber**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-1000  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)  
(stock loose fill and dense pack)

**Home Depot**  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211  
(stock loose fill and dense pack)

*Installers:*  
**CCI California Coastal Insulation**  
801 West Ranger Ave.  
Alameda, CA  
(510) 337-0782

**F. Rodgers Insulation & Interiors**  
7085 Las Positas Rd.  
Livermore, CA 94550  
(925) 294-9400

**Guaranteed Energy Solutions**  
Martinez, CA 94553  
(925) 228-1002



**McHale Insulation Company**  
1300 Galaxy Way  
Concord, CA  
(925) 825-9780

### **COTTON FIBER INSULATION**

**ULTRA TOUCH**  
Manufacturer:  
**Bonded Logic, Inc.**  
411 East Bay Road  
Chandler, AZ  
(480) 812-9114  
[www.bondedlogic.com](http://www.bondedlogic.com)

Available at:  
**Golden State Lumber**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-1000  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

### **RECYCLED CONTENT FIBERGLASS INSULATION**

**INSULSAFE IV**  
(Formaldehyde Free, Blown in)  
Manufacturer:  
**CertainTeed Corporation**  
(800) 441-9850  
[www.certainteed.com](http://www.certainteed.com)

Distributor:  
**Certain Teed Corp.**  
2021 Las Positas Ct.  
Livermore, CA 94550  
(925) 606-7434

Available at:  
**Installer: CALPLY**  
31625 Hayman St.  
Hayward, CA  
(510) 429-8877  
[www.calply.com](http://www.calply.com)  
(special order, call ahead)

**Century Insulation**  
203 Teal Court  
Benicia, CA 94510  
(707) 745-1203

**MIRAFLEX (Formaldehyde Free)**  
Manufacturer:  
**Owens Corning Fiberglass**  
(800) 828-7155  
[www.owenscorning.com](http://www.owenscorning.com)

Available at:  
**Ashby Lumber**  
824 Ashby Ave.  
Berkeley, CA 94710  
(510) 843-4832

**Cameron-Oakland (Wholesale)**  
5401 San Leandro St.  
Oakland, CA 94601  
(510) 533-5121

**Home Depot**  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211

**Pacific Supply**  
1735 24th St.  
Oakland, CA 94608  
(510) 832-5734  
[www.paccoast.com](http://www.paccoast.com)

**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)

### **DECKING-CERTIFIED WOOD**

Manufacturer/ Mill:  
**Big Creek Lumber Co.**  
3564 Highway I  
Davenport, CA 95017  
(831) 423-4156  
(Will deliver to Bay Area - call for  
minimums)

**Beronio Lumber Co. (FSC Redwood)**  
2525 Marin St.  
San Francisco, CA 94124  
(415) 824-4300

**Earth Source (FSC)**  
1020 Heinz Ave.  
Berkeley, CA 94710  
(510) 549-3000  
[www.earthsourcewood.com](http://www.earthsourcewood.com)

**Golden State Lumber (FSC Redwood)**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-1000  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

**Plywood and Lumber Sales (FSC)**  
4050 Horton St.  
Emeryville, CA 94608  
(510) 547-7257  
[www.pals4wood.com](http://www.pals4wood.com)

**Truitt and White (FSC Certified 2x6  
and 2x4 Redwood )**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)

### **RECYCLED CONTENT PLASTIC AND COMPOSITE LUMBER**

**CARE FREE PLASTIC LUMBER**  
Manufacturer:  
**U.S. Plastic Lumber Company**  
(Plastic Lumber)  
(561) 394-3511  
[www.carefree-products.com](http://www.carefree-products.com)

Available at:  
**Ashby Lumber**  
824 Ashby Ave.  
Berkeley, CA 94710  
(510) 843-4832  
(special order)

**Home Depot**  
[www.homedepot.com](http://www.homedepot.com)  
(770) 433-8211

**Piedmont Lumber**  
351 40th St.  
Oakland, CA 94608  
(510) 658-1826  
(special order)

**Piedmont Wholesale**  
2120 Piedmont Way  
Pittsburg, CA 94565  
(925) 431-1100

**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511  
[www.truittandwhitelumber.com](http://www.truittandwhitelumber.com)  
(special order)

*Recycled Content Plastic  
and Composite Lumber Continued...*

### **NEXWOOD (Composite)**

Manufacturer:  
**NexWood Technology Resources  
Limited**  
(888) 7NEXWOOD  
((888) 763-9966)  
[www.nexwood.com](http://www.nexwood.com)

Available at:  
**Ashby Lumber**  
824 Ashby Ave.  
Berkeley, CA 94710  
(510) 843-4832

**Castro Valley Lumber**  
2495 Castro Valley Blvd.  
Castro Valley, CA 94706  
(510) 351-2333

**Golden State Lumber**  
38801 Cherry St.  
Newark CA 94560  
(510) 818-1000  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

**Piedmont Lumber**  
351 40th St.  
Oakland, CA 94611  
(510) 658-1826

**Piedmont Wholesale**  
2120 Piedmont Way  
Pittsburg, CA 94565  
(925) 431-1100  
(Special Order)

**Richert Lumber**  
5505 Sunol Blvd.  
Pleasanton, CA  
(925) 846-5040

**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511

### **SMART DECK (Composite)**

Manufacturer:  
**SmartDeck Systems**  
(888) 733-2546  
[www.smartdeck.com](http://www.smartdeck.com)

Distributor:  
**Georgia Pacific**  
133 Peachtree Street, N.E.  
Atlanta, GA 30030  
(404) 652-4000  
[www.gp.com](http://www.gp.com)

Available at:  
**Economy Lumber**  
750 High St.  
Oakland, CA  
(510) 261-6100

**Golden State Lumber**  
38801 Cherry St.  
Newark, CA 94560  
(510) 818-1000  
[www.goldenstatelumber.com](http://www.goldenstatelumber.com)

### **TIMBERTECH DECKING (Composite)**

Manufacturer:  
**TimberTech Limited**  
(800) 307-7780  
[www.timbertech.com](http://www.timbertech.com)

Available at:  
**84 Lumber**  
1910 Fairway Drive  
San Leandro, CA  
(510) 352-8484  
[www.84lumber.com](http://www.84lumber.com)

**Hayward Building Supply**  
11 Traynor St.  
Hayward, CA 94544  
(510) 582-6444

*Recycled Content Plastic  
and Composite Lumber Continued...*

**Piedmont Lumber**  
351 40th St.  
Oakland, CA 94608  
(510) 658-1826

**Piedmont Wholesale**  
2120 Piedmont Way  
Pittsburg, CA 94565  
(925) 431-1100

### **TREX PLASTIC DECKING (Composite)**

Manufacturer:  
**Trex Company**  
(800) 289-8739  
[www.trex.com](http://www.trex.com)

Trex is available at most local lumber  
yards and home improvement stores.  
Visit their website [www.trex.com](http://www.trex.com)  
or call (800) 289-8739 to locate the  
closest Trex retailer.

### **LOW AND NO VOC PAINTS**

#### **ENVIRO-COTE (No VOC)**

Manufacturer:  
**Kelly-Moore**  
(800) 874-4436  
[www.kellymoore.com](http://www.kellymoore.com)

Available at:  
**Truitt and White Lumber**  
642 Hearst Ave.  
Berkeley, CA 94710  
(510) 841-0511

**Kelly-Moore Paint Stores**  
4917 International Blvd.  
Oakland, CA  
(510) 533-7700

3981 First St.  
Livermore, CA  
(925) 606-7048

40778 Fremont Blvd.  
Fremont, CA, 94538  
(510) 623-9034

28722 Mission Blvd.  
Hayward, CA, 94544  
(510) 538-8590

4156 Telegraph Ave.  
Oakland, CA, 94609  
(510) 652-4970

15611 Hesperian Blvd.  
San Lorenzo, CA, 94580  
(510) 276-6492

7303 Village Parkway  
Dublin, CA, 94568  
(925) 829-8210

#### **HEALTH SPEC (Low VOC)**

Manufacturer:  
**Sherwin Williams**  
Visit [www.sherwinwilliams.com](http://www.sherwinwilliams.com)  
for local retailer

#### **LIFEMASTER DULUX (No VOC or Mercury)**

Manufacturer: **ICI DuLux Paints**  
(415) 863-7235

Available at:  
**ICI DuLux Paint Centers**  
3356 Piedmont Ave.  
Oakland, CA  
(510) 547-4924

2155 Las Positas, Ste G  
Livermore, CA  
(925) 455-0555

Low and No VOC Paints Continued...

4239 Peralta Blvd.  
Fremont, CA  
(510) 793-9474

#### **PRISTINE ECOSPEC (Low VOC)**

Manufacturer:  
**Benjamin Moore Paints**  
(800) 344-0400  
[www.benjaminmoore.com](http://www.benjaminmoore.com)

Available at:  
**Decorator Paints**  
3307 Grand Ave.  
Oakland, CA 94610  
(510) 836-0820

**Mark's Paint Of Alameda**  
2313 Encinal Ave.  
Alameda, CA 94501  
(510) 522-0717

**Mark's Paint Mart**  
4211 Telegraph Ave  
Oakland, CA 94609  
(510) 653-0986

**Moyers Paint Co Inc**  
351 Lewelling Blvd  
San Lorenzo, Ca 94580  
(510) 278-0321

**Wallpaper Express**  
39183 Farwell Drive  
Fremont, CA 94538  
(510) 793-0999

#### **SAFECOAT (No- VOC, Formaldehyde & Mercury Free)**

Manufacturer:  
**American Formulating &  
Manufacturing (AFM)**  
(800) 239-0321  
[www.afmsafecoat.com](http://www.afmsafecoat.com)

Available at:  
**Real Goods**  
1324 10th St.  
Berkeley, CA 94710  
(510) 558-0700  
[www.realgoods.com](http://www.realgoods.com)

#### **SOLVENT FREE ADHESIVES**

**SONNEBORN PREMIUM  
ADHESIVE (Wood, Concrete  
and Masonry)**  
Manufacturer: **ChemRex, Inc.**  
(952) 496-6000

Available at:  
**White Cap**  
297 South Wasco Road  
Livermore, CA  
(925) 961-1070

**White Cap**  
1140 Beecher St.  
San Leandro, CA 94577  
(510) 465-3900

#### **THREE IN ONE FLOORING ADHESIVE**

Manufacturer:  
**American Formulating &  
Manufacturing (AFM)**  
(619) 239-0321  
[www.afmsafecoat.com](http://www.afmsafecoat.com)

Available at: **Real Goods**  
1324 10th St.  
Berkeley, CA 94710  
(510) 558-0700  
[www.realgoods.com](http://www.realgoods.com)

#### **FLOORING-WOOD**

**C&K Demolition & Salvage  
(salvaged flooring)**  
718 Douglas Ave.  
Oakland, CA 94603  
(510) 569-2070

**Caldwell Building (salvaged flooring)**  
195 Bayshore Blvd.  
San Francisco, CA 94124  
(415) 550-6777

**Eco Timber (FSC)**  
1020 Heinz Ave.  
Berkeley, CA 94710  
(510) 549-3000  
[www.ecotimber.com](http://www.ecotimber.com)

**Golden State Flooring**  
680 8th St. #169  
San Francisco, CA 94103  
(415) 522-5120

**J.E. Higgins Hardwoods (FSC)**  
(Golden State Warehouse)  
240 Littlefield Ave.  
So. San Francisco, CA 94080  
(650) 872-2163  
[www.higlum.com](http://www.higlum.com)

#### **RECYLED CONTENT CARPETING, BACKING AND PADDING**

**IMAGE CARPET**  
Manufacturer:  
**Mohawk Carpet**  
(800) 266-4295  
[www.mohawkcarrpet.com](http://www.mohawkcarrpet.com)

Available at:  
**Anderson Carpet and Linoleum Sales**  
4101 Broadway  
Oakland, CA 94611  
(510) 652-1032

**Brandon Carpet Co.**  
20338 Meekland Ave.  
Hayward, CA 94545  
(510) 538-0992

**Conklin Brothers**  
2999 Teagarden  
San Leandro, CA  
(510) 357-1090

**Local Mohawk Dealers**  
(800) 266-4295 or  
Shawn Carlson  
(415) 245-0324

**RENEW CARPETING**  
Manufacturer:  
**Shaw Industries, Inc.**  
(800) 342-7429  
[www.shawcontract.com](http://www.shawcontract.com)

Available at:  
**Shaw Carpet and Floor Center**  
3191m Crow Canyon Place  
San Ramon, CA  
(925) 866-2200

#### **SUSTAINABLE FLOORING NATURAL LINOLEUM**

**DLW NATURAL LINOLEUM**  
Manufacturer:  
**Armstrong World Industries**  
(800) 448-1405  
[www.armstrongfloors.com](http://www.armstrongfloors.com)

Available at:  
**Anderson Carpet and Linoleum Sales**  
 4101 Broadway  
 Oakland, CA 94611  
 (510) 652-1032

**Conklin Brothers**  
 2999 Teagarden  
 San Leandro, CA  
 (510) 357-1090

**Prosource**  
 3051 Teagarden  
 San Leandro, CA 94577  
 (510) 614-9435  
 (trade only)

**MARMOLEUM NATURAL  
 LINOLEUM**  
 Manufacturer:  
**Forbo Industries, Inc.**  
 (800) 842-7839  
[www.forbo-industries.com](http://www.forbo-industries.com)  
 No. CA Sales:  
**Compass Concepts**  
 (800) 543-6033

Available at:  
**Anderson Carpet and Linoleum Sales**  
 4101 Broadway  
 Oakland, CA 94611  
 (510) 652-1032

**Conklin Brothers**  
 2999 Teagarden  
 San Leandro, CA 94577  
 (510) 357-1090

**Prosource**  
 3051 Teagarden  
 San Leandro, CA 94577  
 (510) 614-9435  
 (trade only)

## RECYCLED CONTENT CERAMIC TILE

**ENVIRONMENTAL STONE**  
 Manufacturer:  
**Environmental Stone Products**  
 (888) 629-1969  
[www.environmentalstone.com](http://www.environmentalstone.com)  
 (Mail Order Only)

**SUMMITVILLE RECYCLED  
 PORCELAIN TILE**  
 Manufacturer: **Summitville Tiles**  
 (330) 223-1511  
[www.summitville.com](http://www.summitville.com)

Available at:  
**Western Tile Design Centers**  
 1290 Diamond Way  
 Concord, CA  
 (925) 671-0145

11825 Dublin Blvd.  
 Dublin, CA  
 (925) 829-5544

**TERRA GREEN CERAMIC TILES**  
 Manufacturer:  
**Terra Green Ceramics**  
 (765) 935-4760  
[www.terragreenceramics.com](http://www.terragreenceramics.com)

Available at:  
**California Tile and Stone**  
 1025 Carleton #12  
 Berkeley, CA  
 (510) 601-7565

**Tile and Stone Concepts**  
 2073 Mt Diablo Blvd.  
 Walnut Creek, CA  
 (925) 944-7800

E-spec (Trade Only)  
 4723 Tidewater Avenue Suite J  
 Oakland, CA 94601  
 (510) 536-2600  
[www.ecorep.com](http://www.ecorep.com)

## BAMBOO

**BAMBOO HARDWOODS FLOORING**  
**Bamboo Hardwoods Inc.**  
 (510) 548-4914  
[www.bamboohardwoods.com](http://www.bamboohardwoods.com)  
 Sales Representative: Mari Strain

**BAMBOO FLOORING**  
**Eco Timber**  
 1020 Heinz Ave.  
 Berkeley, CA 94710  
 (510) 549-3000  
[www.ecotimber.com](http://www.ecotimber.com)

**PLYBOO BAMBOO FLOORING**  
**Smith and Fong**  
 601 Grandview Dr.  
 South San Francisco, CA  
 (650) 872-1184  
[www.plyboo.com](http://www.plyboo.com)

**Prosource** (trade only)  
 3051 Teagarden  
 San Leandro, CA 94577  
 (510) 614-9435

**TOMORROW'S TIMBER**  
**Flourish International**  
 4562-1 East Second Street  
 Benicia, CA 94510  
 (707) 748-7906  
[www.Flourishinternational.com](http://www.Flourishinternational.com)

## CORK FLOORING

**ACOUSTI CORK**  
 Manufacturer:  
**Amorim Industrial Solutions**  
 Call 800-255-2675 for local  
 distributor

Available at:  
**Golden State Flooring (Showroom)**  
 680 8th St. #169  
 San Francisco, CA 94103  
 (415) 522-5120

**ALL NATURAL CORK FLOATING  
 FLOOR AND PARQUET TILES**  
 Manufacturer:  
**Natural Cork, Ltd. Company**  
 (800) 404-2675  
[www.naturalcork.com](http://www.naturalcork.com)

Available at:  
**Abbey Carpet of San Francisco**  
 3100 Geary Blvd.  
 San Francisco, CA 94118  
 (415) 752-6620

**Blodgett's Floorcovering**  
 3291 Mt. Diablo Court  
 Lafayette, CA 94549  
 (925) 284-4807

**CEM**  
**The Showcase**  
 2 Henry Adams Ste m6  
 San Francisco, CA 94103  
 (415) 861-8831

**Prosource**  
 3051 Teagarden  
 San Leandro, CA 94577  
 (510) 614-9435  
 (trade only)

*Cork Flooring Continued....*

#### **DODGE CORK TILE**

Manufacturer:

**Dodge-Regupol Inc.**

(800) 322-1923

[www.regupol.com](http://www.regupol.com)

Northern CA Sales Representative:

**Bruce Adams**

(707) 938-8431

Installer:

**Perry Cordova Flooring**

(925) 754-7779

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#### **SOLAR HOT WATER SYSTEMS**

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**Forbes Plumbing**

2601 Adeline St.

Oakland, CA 94607

(510) 452-2844

**The Lunt Marymor Company**

1270 45th St.

Emeryville, CA 94608

(510) 985-2889

### **RENEWABLE ENERGY**

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#### **PHOTOVOLTAICS (PV)**

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##### **POWERGUARD AND POWER**

##### **SHADE**

Manufacturer:

**PowerLight Corp.**

2954 San Pablo Ave.

Berkeley, CA 94710

[www.powerlight.com](http://www.powerlight.com)

Installers:

**Light Energy Systems**

965-D Detroit Ave.

Concord, CA 94518

(925) 680-4313

[www.lightenergysystems.com](http://www.lightenergysystems.com)

**Sun Light & Power Co.**

1035 Folger Ave.

Berkeley, CA 94710

(510) 845-299

[www.solarguy.com](http://www.solarguy.com)

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### **Resources for Alternatives to PVC Building Products:**

- ADPSR (Architects / Designers / Planners for Social Responsibility):  
Architectural Resource Database: <http://www.adpsr-norcal.org/>
- Architectural Record Green Database: <http://www.archrecord.com/green/green.asp>
- Environmental Building News/Building Green: GreenSpec Binder Product  
Directory with Manufacturer's Literature: <http://www.buildinggreen.com/>
- Environmental Design + Construction Magazine: on-line articles:  
<http://www.edcmag.com/>
- Green Building Council: <http://www.usgbc.org/>
- Greenpeace PVC Alternatives Database: <http://www.greenpeace.org.au/pvc/>
- HDR Architecture: <http://www.hdrinc.com/sustainable/>
- Healthy Building Network: [www.healthybuilding.net](http://www.healthybuilding.net)